ENGINEERING NEWS-RECORD

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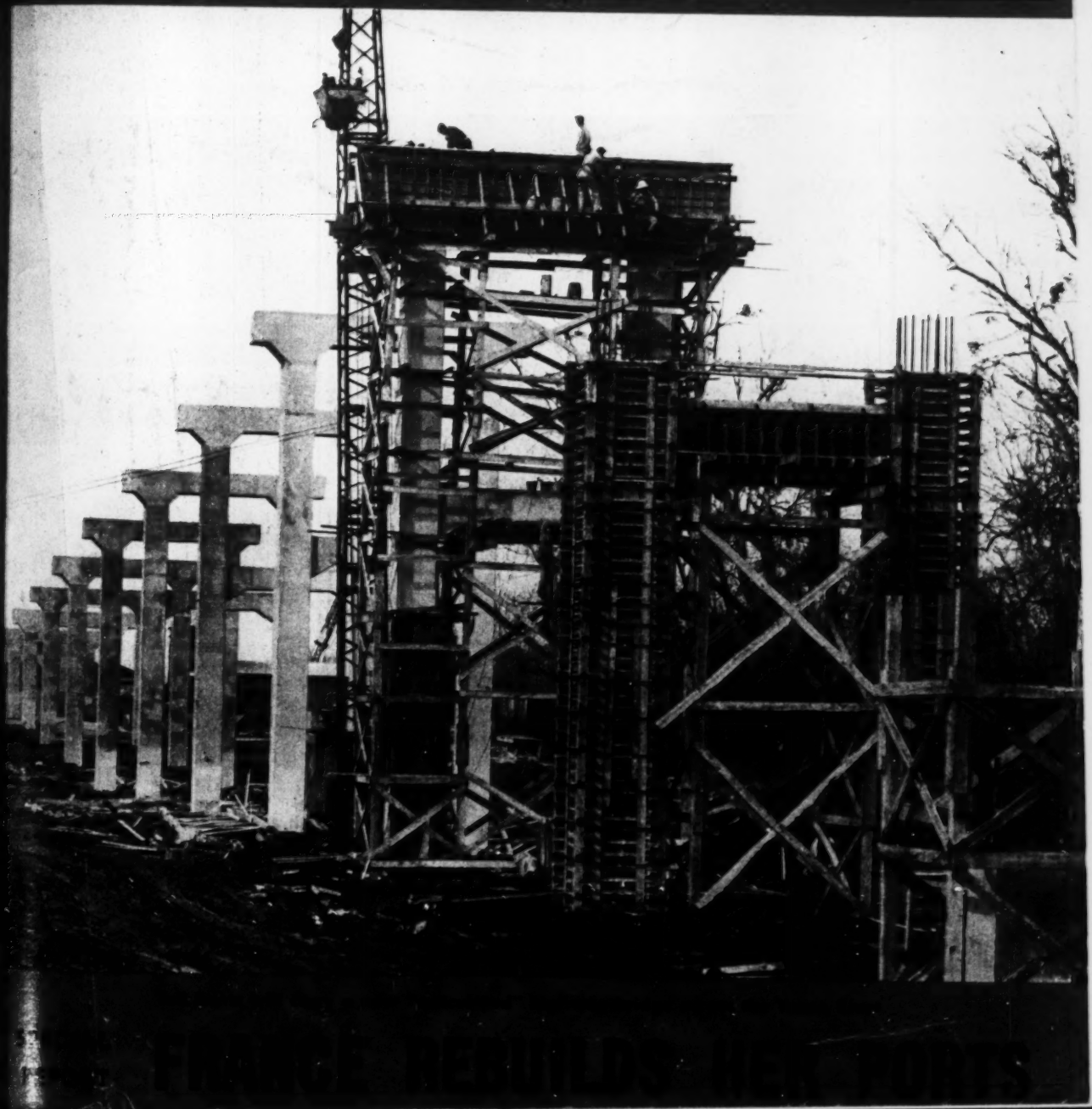
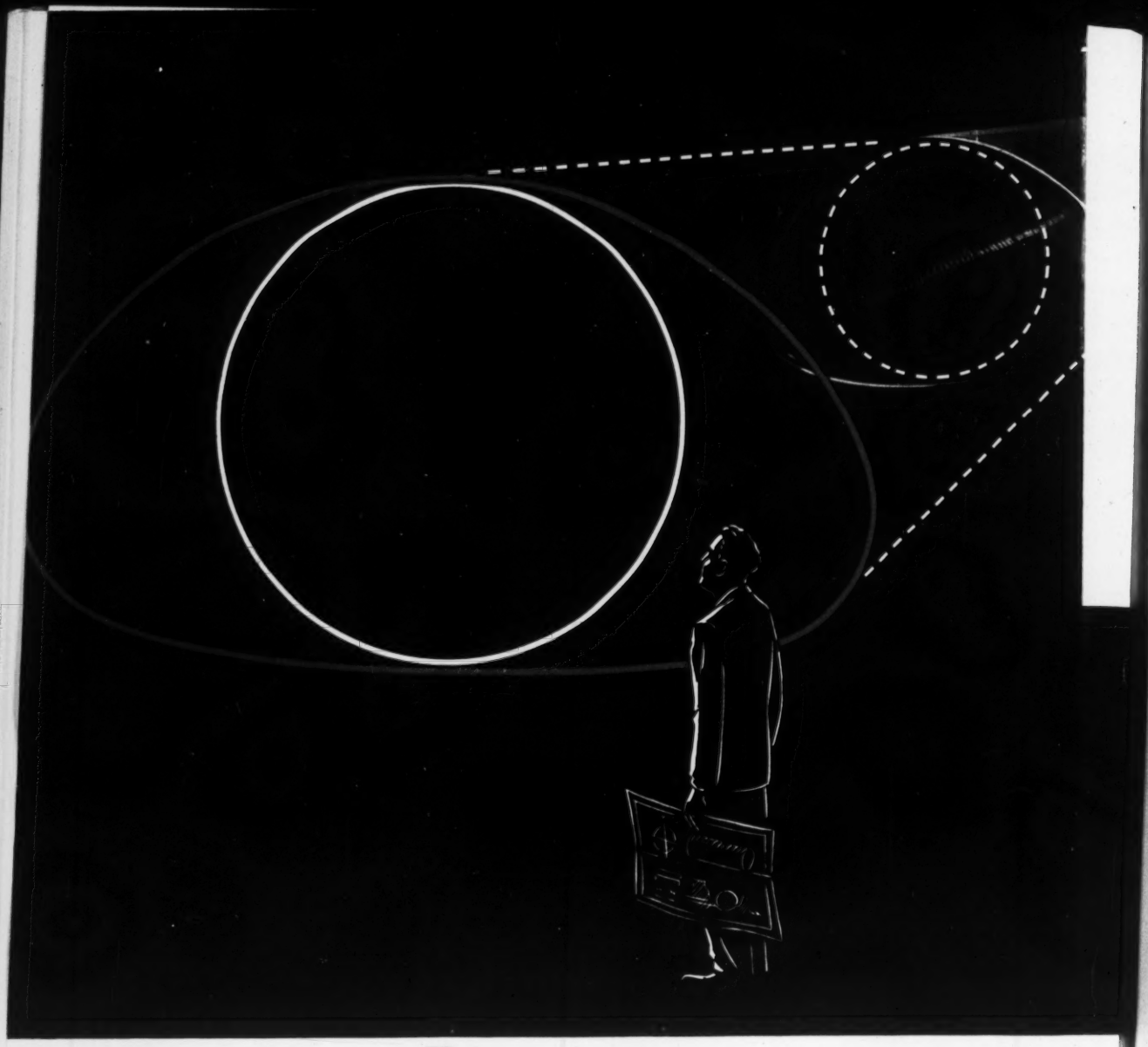
AUGUST 19, 1948





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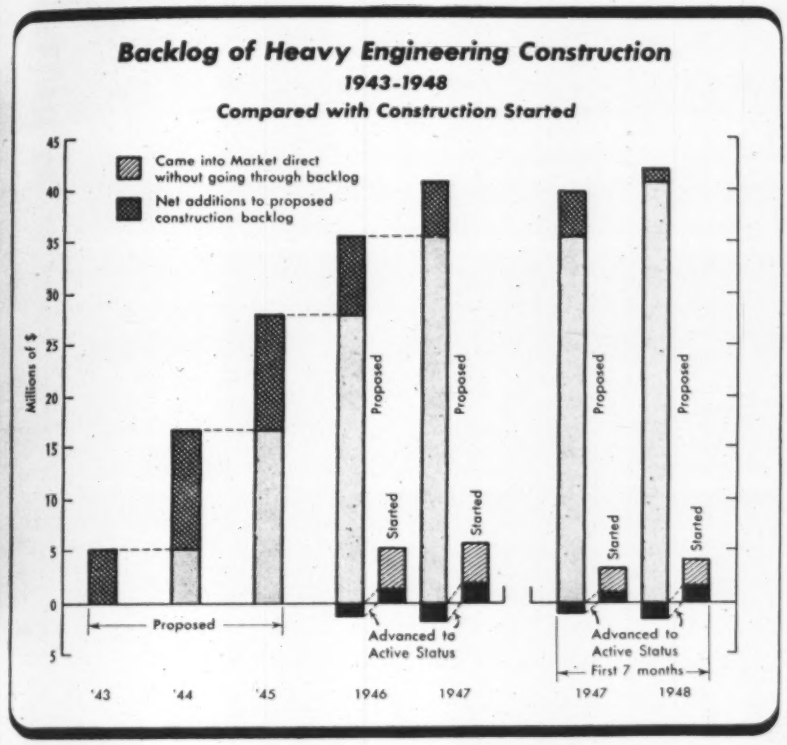


'48 Backlog Growth One-Fourth of '47

Net additions to the *Engineering News-Record* measured backlog of proposed construction amount to $1,150,517,000 for the first seven months of 1948, or only 27 percent of the corresponding 1947 additions of $4,329,578,000. This brings the backlog total to $42,129,046,000, after $1,679,210,000 were deducted for contracts which advanced to active status. The contracts which came out of the backlog during the first seven months of 1948 represent only 4 percent of the entire proposed construction backlog. This backlog in July was equivalent to approximately six years of construction at the present high rate of activity.

Although contracts which advanced to active status out of the backlog now represent 41 percent of total contract awards, compared with 30 percent in the corresponding seven-month period of 1947, the proposed construction backlog is still a conservative measure of needed construction. The remaining 59 percent, or $2,387,782,000, of total contracts awarded through July this year, was not listed first as proposed work, but reported directly from the field as new construction.

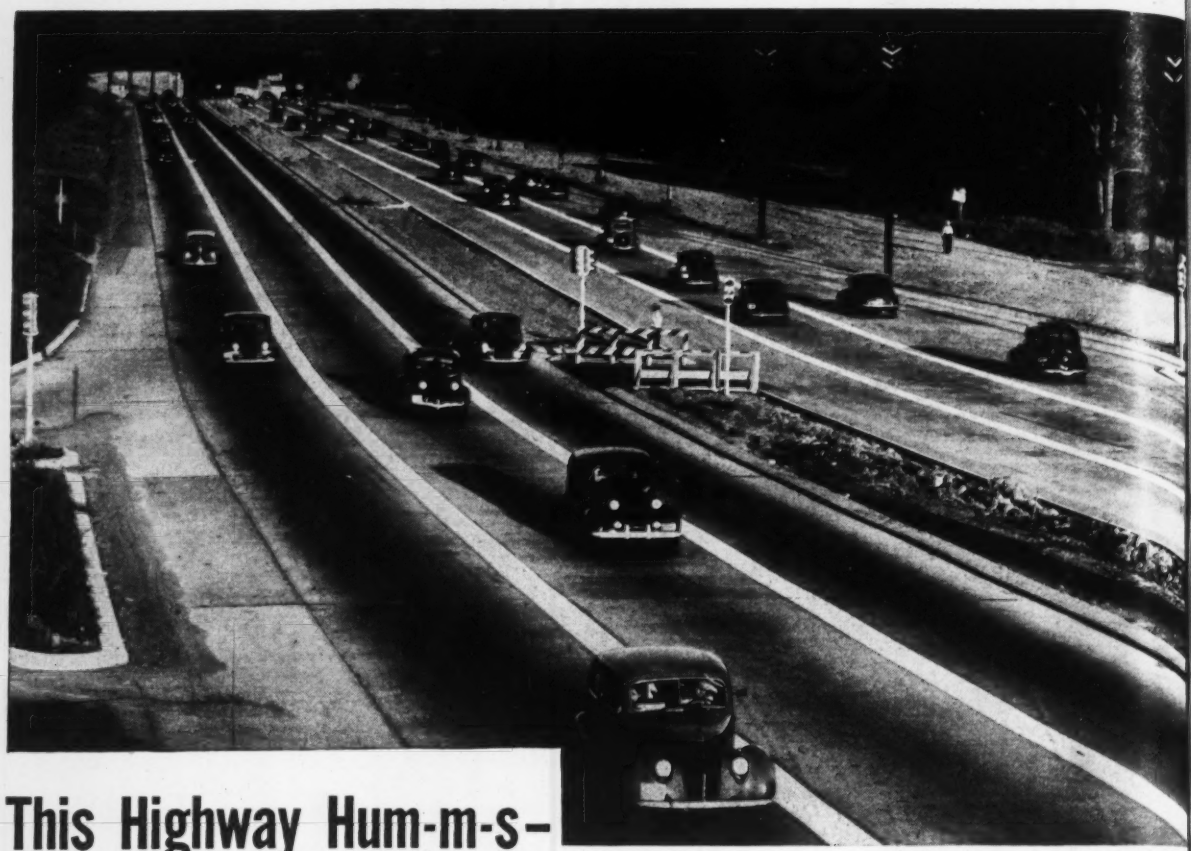
In the classified construction groups, public buildings has the largest backlog cumulative through July 1948, amounting to $9,059,153,000. Unclassified construction and earthwork, irrigation and drainage follow closely recording totals of $8,048,511,000 and $7,435,226,000 respectively. The backlog for commercial buildings amounts to $4,824,493,000; streets and roads to $4,192,801,000; industrial buildings to $3,876,585,000; sewers and sewage disposal units to $2,142,615,000; waterworks to $1,165,238,000.

Total additions to the backlog for all classes of construction so far this year is equivalent to only 3 percent of the backlog total. This compares with a ratio of 11 percent in the corresponding seven-month period of 1947. Only five of the nine individual classes of construction, waterworks, public buildings, industrial buildings, commercial buildings and unclassified construction, showed gains in the backlog during this period. Industrial buildings recorded the greatest gain, $333,000,000, or 9 percent of the industrial building backlog. Ratio of public buildings was 7 percent; commercial buildings, 4 percent; unclassified construction, 3 percent; waterworks, 1 percent. Sewerage, bridges, earthwork and drainage and streets and roads backlogs in July were below the December 1947 totals. The ratio of new proposed construction for the corresponding period of 1947 to the respective backlog totals showed a wide range from 28 percent for industrial buildings to 1 percent for earthwork and drainage construction.

Projects which advanced to active status totaled $1,679,210,000 so far this year, compared with the $963,851,000 which came out of the backlog in the corresponding period last year. Of this year's total, commercial buildings accounted for 24 percent; public buildings for 22 percent; industrial buildings for 15 percent; unclassified construction for 14 percent; earthwork and drainage for 8 percent; streets and roads for 6 percent; sewerage for 5 percent and waterworks and bridges for 3 percent each.

Geographically, West of the Mississippi has the largest backlog total of $10,844,890,000, or 26 percent of the U. S. total. Middle Atlantic follows a close second with a $10,509,438,000-total, 25 percent of the U. S. backlog. Far West has a backlog of $8,061,934,000, 19 percent of the total; Middle West, $6,437,937,000, 15 percent of the total; South $4,253,424,000, or 10 percent; New England $2,021,403,000, or 5 percent.

Gains in the backlog during the first seven months of this year were recorded in five of the six sections listed above. Far West showed a gain of $398,715,000, or 5 percent; Middle Atlantic, $352,945,000 and West of the Mississippi $322,564,000, each a gain of 3 percent; South $87,295,000, or 2 percent; New England $16,197,000, or 0.8 percent and Middle West a loss of $27,219,000, or a loss of 0.4 percent.



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News of the Week

ENGINEERING NEWS-RECORD • AUGUST 19, 1948 • VOLUME 141 • NUMBER 8

Steel allocation is approved for prefab home builders

Other users' protests lose out to industry's claim as low-cost home producer—Sufficient steel allotted for 6,000 houses in next seven months

Commerce Department approval of the steel industry's agreement to furnish 59,000 tons of sheet and strip to manufacturers of all-steel houses last week ended the first tempest in the brief history of the voluntary allocation program. The request from the prefab companies went through some stormy sessions after it reached the Steel Products Advisory Committee, appointed May 6 by Commerce Secretary Charles Sawyer.

Steel sheet and strip in the amount of 59,000 tons is the minimum needed to permit economical production of houses in the prefab plants during the next six to seven months. The steel will go to six manufacturers, but the principal beneficiary is the Lustron Corp., of Columbus, Ohio.

Voluntary industry allocation agreements made under existing Public Law 395 will expire Feb. 28, 1949, and shipments of allocated materials presumably must be completed by that date. Congress passed the law late in 1947 to let industry work out its own problems in distribution of critically short materials without imposition of government controls. The next Congress, meeting in January, is expected to extend the program.

Allocations opposed

Announcement last May of the prefabricators' request for steel sheet and strip raised a storm of protest from the automobile manufacturers. Top management of some big companies told the Commerce Department that it would be foolish to divert short stocks to untried ventures while production of well-established concerns was being held down by limited supply.

Some Commerce officials held similar opinions but expressed them in milder language. Those opinions ran head on into the administration's policy of doing everything possible to turn out low-cost housing and increase the volume of house construction. Prefabricators of all-steel houses claim low selling prices for completed homes.

More than 6,000 all-steel houses will be manufactured from the 59,000 tons. Lustron reportedly sells its 1,000-sq. ft. house completely erected for $8,000, exclusive of land. Reliance Homes, Inc., Philadelphia, sets a price to builders of $5,500 job factory or $6,000 delivered and erected in Philadelphia for a three-bedroom dwelling, completely equipped except for refrigerator, without land.

Opponents claim that an all-steel house takes a total of 9 to 11 tons of steel. C. B. McGehee, president of the William H. Harmon Co., Wilmington, Del., testified that his firm would manufacture 1,000 all-steel three-bedroom houses with 4,397 tons of sheet and strip that it applied for out of the 59,000-ton allocation. Harmon houses use just under 4.4 tons per dwelling.

Other steel house manufacturers receiving allotments from the 59,000 tons are McKay Homes, Cleveland; The Metalumber Co., Columbus, Ohio, and Macomber, Inc., Canton, Ohio.

Claim labor saving

Manufacturers of all-steel prefabricated houses claim a great saving in labor. Rep. Frank L. Sundstrom of New Jersey said at the OIC hearing that the total human labor required for production and erection of a Lustron house amounts to only about 500 man-hr., in comparison with 1,500 to 2,500 man-hr. of on-site labor alone for a conventional house. The claim

(*Continued on p. 75*)

OK $65 million loan for U. N. building

President Truman's signature on the bill to authorize a $65,000,000 loan for construction of the permanent United Nations headquarters in New York City last week gave the green light to plans long since prepared (*ENR* Oct. 9, 1947, Vol. p. 497).

Assured of funds for a world capital, which will extend from 42nd to 48th Streets and from First Avenue to the Franklin D. Roosevelt Drive along the East River, the U. N. plans to ask for bids on a 39-story secretariat building about Sept. 1 and hopes to begin construction by Oct. 1.

At ceremonies marking the President's signing of the loan bill, Trygve Lie, U. N. Secretary-General, announced that the 16-man U. N. Headquarters Advisory Committee would convene Aug. 19 to formulate a construction schedule.

Mayor William O'Dwyer of New York, also present at the White House ceremony, will call the city Board of Estimate together to consider further the plans for improving areas surrounding the U. N. site. The city will spend approximately $20,000,000 on this work.

The secretariat building, first of the units to be built, should be completed by 1950. Bids will be received on the Security Council building about Oct. 1 and on the General Assembly building about Nov. 1.

The $8,500,000 site, a gift of John D. Rockefeller, Jr., has been prepared for construction by the demolition of tenements, lofts, and other miscellaneous structures.

New York City's part in cleaning up the surrounding area will include widening First Avenue, affording a north-south tunnel under First Avenue from 41st to 47th Streets to keep noisy truck traffic underground, and widening 47th Street from Second Avenue to First Avenue to make a suitable approach to the main entrance of the international zone. Access to Franklin D. Roosevelt Drive at 42nd and 47th Streets will also be improved, to accommodate the increased traffic anticipated by the planners.

NEWS BRIEFS

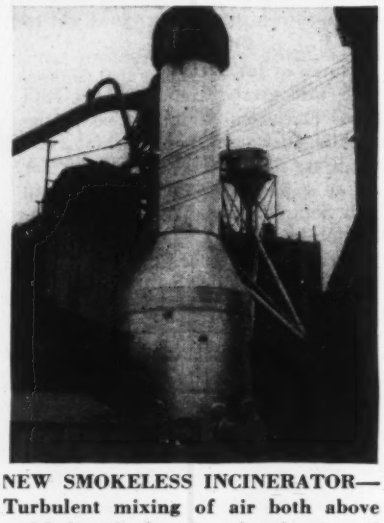
Highways—Average cost per mile to keep up *Texas* highways has increased $44 since last year . . . Engineers' plans for the first projects of the $3,300,000 county road improvement program at *Galveston, Tex.*, have been approved . . . Austin Bridge Co., Dallas, has a $2,457,035 contract for the Nueces Bay causeway at *Corpus Christi, Tex.* . . . The lowest bid on the first section of the North-South Traffic link in *Atlanta, Ga.*, was $1,327,500. . . . Traffic engineers have recommended a toll of $2.50 for a full length auto ride on the Pennsylvania Turnpike when completed to its ultimate length of 260 miles.

Public Construction — Approval has been given for construction projects of $3,043,000 at the University of Florida at *Gainesville* and the Florida State College at *Tallahassee* . . . Canada has granted *Quebec City* $1,600,000 for harbor work . . . A supplementary bond issue for a courthouse for *Harris County, Tex.*, will be voted on in November . . . Architects' plans have been ordered for a new public library at *Minneapolis, Minn.* . . . Bids will be received soon for $3,500,000 worth of construction at the University of Missouri, *Columbia* . . . A 300-bed medical center to cost about $4,000,000 is being considered at *Harrisburg, Pa.* . . . Bids will be opened Sept. 17 for the $5,000,000 VA hospital at *Seattle, Wash.* . . . Proposals are due Sept. 1 for a $400,000 library for Montana State College at *Bozeman* and for a $1,000,000 state office building at Helena . . . Mutual Construction Co. of New York has a $1,379,430 contract for new buildings at the school for the blind at *Batavia* . . . *Boston's* subway program calls for extension of the Washington St. tunnel to Cedar St. at a cost of $19,000,000 and expansion of the Tremont St. subway between Boylston St. and Scollay Square to cost $11,500,000.

Housing—Two housing developments in *Jefferson Parish, La.*, to cost over $2,000,000 are planned by Globe Const. Co. . . . Ground is being broken this month for an $18,000,000 development for 1,000 families on the site of the former Phelps Manor Country Club, *Teaneck, N. J.* . . . Work has started on the $2,000,000 second section of the Maxwell Homes rental project at *Pasadena, Tex.* . . . Construction is about to start on Northlawn and Southlawn veterans' housing projects at *Milwaukee, Wis.*; there will be 580 units in the projects.

Industrial Construction—Work on the superstructure has been started on two of the four large additions to the motor assembly plant of the International Plainfield Motor Co. at *Plainfield, N. J.*, by Wigton-Abbott Corp., total cost to be around $1,500,000 . . . Construction has started on a $1,000,000 research laboratory for the Solvay Process division of Allied Chemical & Dye Corp. at *Syracuse, N. Y.* by H. K. Ferguson Co. . . . Ed Schuster & Co. are having plans prepared for a $4,000,000 program of additions to their 3 department stores at *Milwaukee, Wis.* . . . Mutual Life Insurance Co. has commissioned Shreve, Lamb and Harmon to design its new home office building in *N. Y. City*, and Turner Const. Co. will build the 22-story building . . . A $2,700,000 hydrochloric acid recovery plant will be built at *Texas City, Tex.*, by the Tin Processing Corp. . . . Construction is proceeding rapidly on the $10,000,000 refinery of the Continental Oil Co. at *Billings, Mont.*

Water and Sewers—On Sept. 9 bids are to be opened for a $551,000 rebuilding of the water system at *Ellensburg, Wash.* . . . The first series of trunkline sewer projects at *Rockford, Ill.*, to cost $1,500,000, is nearly completed . . . Officials of Iowa State College and the city of *Ames, Iowa*, are considering bids for a sewage disposal plant . . . *Eugene, Ore.*, water board has awarded a $376,980 contract to Lee Hoffman of Portland for the main structures of a water filtration plant . . . *Dallas, Tex.*, has let contracts for the $1,200,515 White Rock sanitary sewer.



NEW SMOKELESS INCINERATOR—Turbulent mixing of air both above and below the burning chamber is said practically to eliminate smoke from a newly designed industrial incinerator at the Hammond Lumber Co. mill on Terminal Island, Los Angeles Harbor.

Los Angeles sewage plant costs extra $10 million

Steadily rising labor and materials costs as well as delays in progress of construction will boost the cost of the Hyperion sewage treatment plant at least $10,000,000 beyond the estimated $40,000,000 cost, the Los Angeles City Council has been notified (*ENR*, Aug. 12, p. 8).

This emergency was set forth in an official letter to the council from city attorney Ray L. Chesebro, who said plans for submission of a $10,000,000 bond issue to the city's voters at the November general election should be formulated without delay.

Chesebro, in addition to proposing another bond issue to the voters, suggested that authority for imposition of a sewer service charge or creation of a sewage district capable of issuing revenue bonds based on sewer rental charges should be considered.

Chicago to abandon plan for subway terminal loop

Under a new agreement with contractors Chicago has abandoned its plans for a subway terminal loop east of the Chicago River at Congress Street.

Subject to the approval of the city council, S. A. Healy Co., subway contractors, will build twin tubes under the Chicago River at Congress Street at a cost of $1,484,635. The project will be carried out for this amount in return for the city's abandonment of plans for the underground terminal loop

Group to study process in wood-preserving plant

A new group of technical committees to study materials handling and make recommendations for better engineering has recently been announced by J. S. Giddings, first vice-president of the American Wood-Preservers' Association.

Reports from 31 technical committees under the new arrangement will be heard at the 45th annual meeting of the AWPA scheduled for April, 1949.

Materials handling for the 9,000,000 tons of wood products processed annually through 310 plants in the industry is a major problem. The 77 million pieces of treated wood which must be handled at least five times at a plant vary in size from treated factory-flooring blocks to large telephone poles and piles.

Use of pressure treated wood for highway construction will be the subject of a report by another committee.

Approve steel industry allocations

(*Continued from p. 73*)

carries weight in these days of manpower shortage.

Other voluntary industry agreements for allocation of iron and steel have gone through with less contention. In total, they add up to a sizable portion of the industry's capacity. Only the prefab house program represents acceptance of a new end use for steel. The other allocation agreements are merely voluntary commitments to deliver stated quantities to users who would be getting as much steel—or 75 to 80 percent as much—anyway.

The voluntary agreements program is rolling right along. Last week, just two days after Commerce Secretary Sawyer approved the steel housing allocation, the Steel Products Advisory Committee put its approval on allocation of 40,000 tons per month for construction of tankers and 2,000 tons per month to build research facilities for the national advisory committee for aeronautics. These actions—like all allocation approvals of the steel products group—are subject to review by the steel producers advisory committee.

In all, the steel allocations now in effect come to 440,000 tons a month, and pig iron allocations to 170,000 tons. The steel allotments mean definite commitment until March 1, 1949, of 8 percent of our production capacity.

Allocation method outlined

Public Law 395, which exempts industry allocation agreements from antitrust action, was signed Dec. 30, 1947. On Jan. 3 of this year the President by executive order directed the Secretary of Commerce to handle all industry agreements for industrial materials. For this work, the secretary created a separate organization in the department.

Allocation agreements come about in this way. After receiving the recommendations of the advisory committee of a steel consuming industry—such as the warm air heating equipment manufacturers—the Secretary of Commerce submits a suggested program, with supporting data, to the Steel Producers Advisory Committee.

If the producers group recommends an allocation for the consuming industry, the Secretary sends the proposed program to the director of the iron and steel division for review by the Steel Products Advisory Committee. The committee is made up of representatives of the steel producing companies responsible for sales and distribution. Should this group approve the plan, it goes next to a task force of members of the steel producing industry appointed by the Secretary of Commerce. This group recommends what it considers equitable allocation of tonnage, by products, among the steel producers.

Work of the steel committees is supplemented by a Pig Iron Industry Advisory Committee.

To aid housing construction, warm air heating equipment gets 29,500 tons of steel a month, and a total of 107,000 tons per month of pig iron is allocated to manufacturers of cast-iron pressure pipe, soil pipe, boilers and radiators, furnaces, and plumbing drains.

Steady increase seen in cement production

Productivity has risen steadily in the cement industry and recovered from the severe drop suffered during the war years. That's the finding of a Bureau of Labor Statistics study which puts 1947 productivity in this industry at its highest point since 1939.

On the basis of 1939, total production is up 51.8 percent, while the number of workers has increased 25.5 percent and the total number of hours worked has risen 37 percent. Also, the amount of cement produced by each worker is 21 percent higher than 1939.

But the real measure of increased productivity is the amount of cement produced for each hour worked. That is 10.8 percent higher. This does not mean that labor was 10.8 percent more efficient.

As explained by BLS, the output per man-hour reflects "the joint effect of a large number of separate, though interrelated, influences." Among the "influences" it lists technical improvements, the rate of operations, the relative contributions to production of plants at different levels of efficiency, the flow of materials and components, the skill and effort of the workers, the efficiency of management and the state of labor relations.

The "cement industry" used by BLS in its study corresponds with that used for the 1939 census, including plants primarily engaged in making portland, natural, masonry and puzzolan cements.

Houses begun in July exceed 90,000 mark

Volume of new houses started in July showed little effect of the lapse in FHA Title VI insured mortgage financing on April 30. Builders started 94,000 new permanent non-farm dwelling units last month, according to preliminary estimates of the Bureau of Labor Statistics, Department of Labor. Activity in July showed an increase of 12,900 units over the same month in 1947. July was the fourth consecutive month this year in which housing starts exceeded the 90,000 mark.

Los Angeles leads the nation in the number of building permits issued during the first 7 months of the year with a total of 18,345 permits, while New York City is second with 13,440.

Multi-million pulp mills for Alaska

Acceptance by the U. S. Forest Service of the Ketchikan Pulp & Paper Co. bid for 1,500,000,000 cu.ft. of pulp timber near Ketchikan, Alaska, clears the way for establishment of the first pulp mill in the territory.

Surveys for the $25,000,000 mill are already under way at the site, in Ward's Cove on Revillagegido Island, six miles north of Ketchikan. Construction is scheduled to begin next summer. Ketchikan Pulp & Paper is an affiliate of the Puget Sound Pulp & Timber Co. of Bellingham, Wash.

The Forest Service said the total timber which eventually will be disposed of will amount to 8 billion c.f. and all of it will be cut on a sustained yield basis, furnishing timber for the mill in perpetuity. The company said the 8 billion c.f. of timber will produce approximately 8 million tons of pulp and should keep the proposed mill producing 500 tons of pulp a day for the next 80 years.

American Viscose Corp., a large consumer of dissolving pulp, is associated with Puget Pulp in the ownership of common stock of the Ketchikan company.

The sale to Ketchikan Pulp is the first of five or six forest units in the Tongass National Forest which the government plans to sell by calling for construction of mills in Alaska.

The company must qualify for a federal water power license within one year and show assets to enable it to construct the mill.

Another company, the Alaska Industrial Corp., seeks to construct a dissolving rayon pulp mill costing at least $15,000,000 at Sitka. A site has been selected at Sawmill Creek, six miles from Sitka, and the Harza Engineering Co. of Chicago has been engaged in a consulting capacity. The plant should be in operation by the end of 1950 with a daily production capacity of between 200 and 250 tons.

Engineering congress to meet at Liege

The third congress of the International Association for Bridge and Structural Engineering will be held at Liege, Belgium, Sept. 13-18, with M. Behogne, Belgian Minister of Public Works, in the chair at the opening session.

Among the subjects to be discussed will be: (1) Assembling devices and structural details in steel construction; (2) developments in building structure in concrete and masonry; (3) developments in long-span steel bridges; (4) slabs and various curved structures in reinforced concrete; and (5) analysis of safety factor and effect of dynamic forces.

Some of the technical details to be considered under the above include:

1. Fundamental technical details regarding materials, shrinkage effects, questions of manufacture, proportioning, connections for trusses and rigid frames.

2. Increase of compressive and tensile strength of concrete, expansive concrete, deterioration, vibration, shrinkage, creep, plastic deformation of reinforcement, erection methods, economy, reinforcement, and bridges and other structures in prestressed concrete.

3. Weight and cost of principal system, lateral rigidity, steels other than ordinary mild steel, foundation conditions, erection, new contributions to the theory of suspension and long-span arch bridges, dynamic and aero-dynamic influences, and design of floors.

4. Theory and methods of calculation, approximation, varying flexural rigidity, stability, contraction, temperature measurment, twisting moments, and foundation yielding.

5. Analysis of safety (deformation, cracks, rupture, wear), testing of materials, checking results in steel, concrete and masonry structures.

"Feather-weight" aggregate now in full production

Formation of the Perlite Manufacturing Co. of Carnegie, Pa., to process and distribute perlite—a lightweight aggregate—has been announced by T. Coleman Ward, Jr., president. The company is believed to be the first in the East to begin full scale production.

The raw perlite, a glasseous, volcanic rock, is imported from the Rocky Mountain region, pulverized, and heat-treated. The company's furnace, with one calcining unit, is capable of producing a minimum of 110 cu. ft. of perlite per hour. The plant's entire output for the first three weeks has already been sold, Mr. Ward reports.

The perlite is pure white and weighs only 3 to 12 lb. per cu. ft. Bricks formed from it are so light that they float in water when waterproofed. Concrete blocks of perlite aggregate weigh only about one half of the standard block, and have an insulating value of approximately 20 times the latter, according to the manufacturers. Concrete slabs made of perlite have the same insulating value and are fire retarders.

As a plaster base, perlite is claimed to lighten plaster weight as much as a ton for a normal sized room, and to double the speed with which plaster can be applied.

Processing procedure is as follows: The rock is crushed to proper size, first preheated to 900° F. and then to 2000° F., thus vaporizing a small amount of water "in solution" in the rock. Steam so formed puffs up into bubbles within the softened material. Rapid cooling then traps the bubbles within the perlite granules. This "popping" expands the product 6 to 10 times its original size without any increase in weight. The entrapped bubbles are what give the material its unique properties.

Bureau of Reclamation Photo

MAN-MADE "KINK" IN COLORADO RIVER—Diversion necessary at Davis Dam site put this temporary bend in the river while Bureau of Reclamation engineers prepare original channel for excavation and placing of earth and rock-fill dam (ENR, Aug. 5, p. 71). This view of the project, 67 miles below Hoover Dam, is taken looking downstream; concrete power plant intake and spillway structures are to be at the far end of the channel.

Bidding varied widely on Alaska airport work

Tabulation of the bids for engineering work on two new airports for the Civil Aeronautics Authority at Anchorage and Fairbanks, Alaska, (*ENR*, July 29, p. 3 and Aug. 12, p. 2) shows that engineers' estimates of the cost of doing the work varied widely. The firms that bid and the amount of their proposed fee are as follows:

ANCHORAGE AIRPORT
(opened July 15)

Thos. B. Bourne Associates (Award)	$232,000
Flora Engineering Co.	$232,500
Airways Engineering Consultants, Inc.	$255,000
Gustav Karla	$272,000
Michael Baker, Jr.	$350,000
M. C. Hoppin & Associates	$582,353

FAIRBANKS AIRPORT

Michael Baker (Award)	$135,000
Thos. B. Bourne Associates	$188,000
M. C. Hoppin & Associates	$202,000
Airways Engineering Consultants, Inc.	$245,000
Flora Engineering Co.	$267,500
W. T. Batcheller	$248,600
DeWitt C. Griffin & Associates	$377,000

Several engineering firms that were asked to bid refused because bids were asked on a standard government construction contract, which requires a 10 percent bid bond, 50 percent performance bond and payment of liquidated damages at the rate of $200 per day.

Federal groups complete pollution control plans

States must initiate action for loans from yearly authorization of $22,500,000 okayed by Congress

As a first step in implementing the new stream pollution control law, officials of the Federal Security Agency, the U.S. Public Health Service, and the Federal Works Agency completed preliminary plans last week for a national water pollution control program.

Meeting in the office of Maj. Gen. Philip B. Fleming, Federal Works Administrator, they agreed on general operational policies. The program will get under way as soon as Congress appropriates funds authorized for the work in the last regular session.

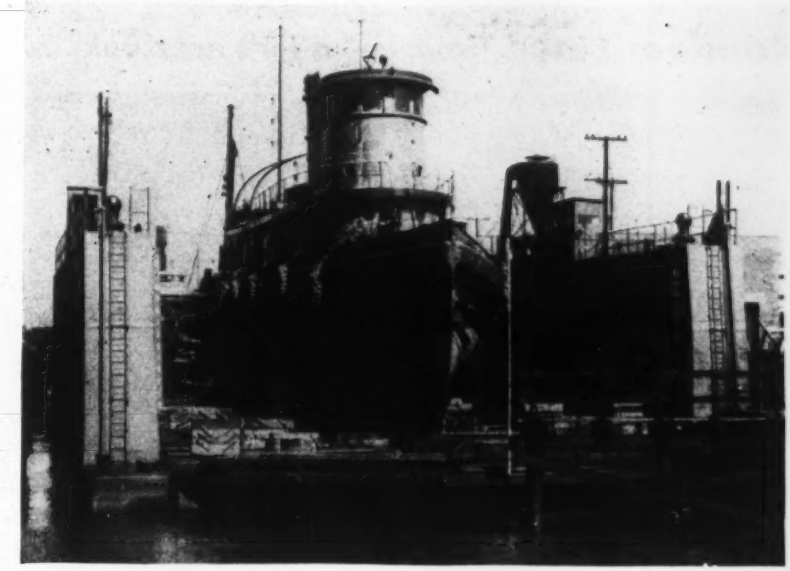
Those attending the meeting with General Fleming were: J. Donald Kingsley, assistant administrator, FSA; Dr. Leonard A. Scheele, surgeon general, USPHS; Mark D. Hollis, assistant surgeon general and chief of the sanitary engineering division, USPHS; George H. Field, commissioner, Bureau of Community Facilities, FWA (whose organization will administer the Federal Works Agency's phase of the program), and Maxwell H. Elliott, acting general counsel, FWA.

Primary responsibility for the program rests with the states (*ENR, June 24, Vol. p. 999; July 1, p. 1; and July 15, p. 7*). The act provides for preliminary investigations and the preparation of a nation-wide program of pollution control by the Public Health Service of FSA in cooperation with FWA and state and interstate water pollution control organizations.

When funds are appropriated, the Federal Works Administrator will make grants, after approval by USPHS and the state pollution control authorities, for plan preparation of sewage treatment plants. These grants are limited to a total of $1,000,000 a year for five years. No grant may exceed $20,000 or one third of the cost of the planning work, whichever is smaller.

Loans for both construction and engineering work on approved plants will be made from an authorization of $22,500,000 a year for five years. No loan may exceed $250,000 or one third of the cost of the project, whichever sum of money is smaller.

In addition, the act provides for an appropriation of $5,000,000 to be used at the rate of $1,000,000 a year for five years. These funds are to be administered by USPHS and allotted by the U. S. Health Public Service to the states to make studies of methods to control pollution of waterways by industrial wastes.



ERIE RAILROAD'S FLOATING DRYDOCK—Maintenance of its 234 vessels operating around New York harbor is now accomplished by the Erie Railroad in a new 400-ton floating dock. Operated by a crew of six, the 110-ft. long submerged dock can be pumped out and raised in 51 minutes.

Standards set for European highways

Western European nations have expanded and refined their recommendations for highways in the international network. The working party on highways of the United Nations' Economic Commission for Europe at its second meeting, held in Geneva, Switzerland, last month, adopted procedures and standards for development of the 12,000-mile international road system agreed upon last April (*ENR May 27, Vol. p. 759*).

Representatives of nine nations attended the second meeting. Highway officials came from two countries behind the iron curtain—Czechoslovakia and Poland—in addition to those from the seven western nations represented at the first meeting. The seven nations are Belgium, Denmark, France, Italy, the Netherlands, Sweden and Switzerland. As before, the British and U. S. zones in Germany also participated, representatives being present for both the United Kingdom and the United States.

Primary purpose of the highway group is to build up the European network to facilitate transport of goods between nations during the reconstruction period of the Marshall Plan and thereafter. To carry out this aim, the highways are to be improved and constructed according to uniform standards applying in all the participating nations. The plan is allied with an informal agreement now in effect that permits free passage of truck traffic across international boundaries, without the costly delay of transshipping from one vehicle to another at border points.

Agreement was reached at the second meeting on permissible traffic densities for the classes of roads previously adopted. As a measure of traffic density, the highway group recommended a figure between the average hourly traffic of the week and the absolute peak hour traffic.

For the two main types of highways, the meeting established these traffic standards: Category I, two-lane roadway 7 meters (22 ft.) wide, maximum permissible density of 500 vehicles per hour where only motor traffic is allowed or 400 vehicles where other traffic is permitted; Category II, four-lane divided highways with two 7-meter roadways separated by a median strip, recommended for densities greater than those permitted for Category I. No similar determination was made for three-lane roads 10 ½ meters (34¼ ft.) wide in Category III, as this classification is a provisional type to be built only where physical and economic conditions prohibit divided four-lane construction.

Throughout the system, roadway width is to be maintained on bridges and in tunnels and underpasses, and bridges are to be designed to uniform live load capacity, not yet established. Minimum highway clearance under bridges is 4½ meters (14¾ ft.). Most of the countries declared separate cyclist tracks to be necessary where roads carry more than 500 bicycles a day.

Random Lines from an editor's notebook . . .

. . . . In which is an account of how Akron, Ohio, has utilized its watershed as a business and recreation venture, without nullifying health and conservation standards.

Should watershed areas be set aside for nothing but water-supply purposes? Or can they be put to other productive uses without nullifying public-health and conservation standards?

While some authorities contend that watersheds should be maintained completely inactive to protect water quality, other engineers are encouraging development of natural resources on those normally sterile areas with no detrimental sanitary effects.

An example of watershed utilization is found at Akron, Ohio, where conservation, agricultural and recreation projects on the watersheds of Lake Rockwell and Mogadore Reservoir not only produce substantial annual returns but also create considerable good will and civic support for waterworks improvements.

Reflects imagination

Success of the watershed-utilization program reflects the imagination and enthusiasm of Wendell R. LaDue, superintendent and chief engineer of the Bureau of Water and Sewerage and past-president of the American Water Works Association, who has sponsored and guided the work since its inception in 1921.

Among the profitable enterprises on the two watersheds are: planned reforestation; selective lumbering operations; productive orchards; controlled fishing privileges; leased farms; cattle and sheep raising; and the largest maple-sugar "bush" in Ohio.

In the course of a recent survey of the reservoir sites, Mr LaDue pointed out the extent to which reforestation has been practiced. While most of the non-agricultural area (4,000 acres) is covered with an attractive mixture of coniferous and deciduous trees, the remaining fallow-field sections are gradually shrinking due to yearly additions to the forest preserve.

Replying to the question as to the value of reforestation on watersheds, Mr. LaDue stated that trees actually decrease total yearly yield of water by absorbing water for growth, but their root systems, which act as sponges, permit gradual discharge at times when water is needed most. In short, they assure "controlled distribution."

Trees that reach the limit of useful life are marked during a yearly inspection and cut when labor demands on other waterworks jobs are at a minimum. These trees are not wasted but are converted into usable lumber on a portable saw mill.

Selective lumbering operations have been so successful, Mr. LaDue said, that no sheeting or blocking for waterworks excavations has been purchased for 18 years.

Some 250 acres of apple, cherry and pear trees adjacent to Lake Rockwell bring in a clear profit of $2,500 per year from a private concern which rents the acreage.

Fishing privileges permitted

Recreation activity on the Mogadore industrial-water reservoir is limited to fishing. During the 90-day annual season, fishing is permitted on about one-third of the total reservoir area (1,000 acres). Boats are rented for 75 cents a period ($1.00 on Sundays and holidays) and a returnable $3.00 deposit for oars and anchor.

The water department maintains a fleet of 52 rowboats and boat-house facilities for the convenience of fishermen. Private boats and motors are not permitted on the reservoirs.

Regulations governing use of reservoirs for fishing were drawn up in consultation with 18 sportsmen's organizations representing about 20,000 members. As a consequence of cooperative planning and the fact that a valuable privilege is being made available, these groups police their own membership to insure compliance with regulations.

Another valuable enterprise on the watershed is farming. More than 90 farms owned by the city are being operated profitably by tenants. A yearly income of over $7,500 is realized from farm rentals.

Under one part of the farm program, large herds of cattle and sheep graze on a 2,000-acre future reservoir site that was cleared during the 1930 depression. The farms are self-sustaining; no feed for the herds is purchased. All ensilage and hay required for cattle and sheep is grown on the farms (16,000 bales of hay were harvested last year), it is estimated. Mr. LaDue emphasized, that an annual saving of $20,000 results from use of livestock to preserve the original investment in a cleared reservoir site.

Somewhat of a novelty in municipal enterprises, the largest maple-sugar "bush" in Ohio is operated in the forest preserve. The size of this venture may be gaged by the fact that 800 gal. of maple syrup were produced in 1947. (It requires 50 gal. of sap to make one gallon of syrup).

If a municipal official is considering utilization of water-supply watershed resources, he should plan to visit the Akron program. There he will find ready guidance from an enthusiastic conservationist and a practical but imaginative manager — Wendell R. LaDue.—*J.C.B.*

Propose two canals to end Texas water shortage

Farmers in the Rio Grande Valley of Texas, facing the loss of fertility of 70 percent of their land because of seasonal shortages of irrigation water, are pinning their hopes on plans for two canal projects being prepared by the U. S. Bureau of Reclamation.

One project calls for 290 miles of drainage canals and the other for a 239-mile gravity canal to bring irrigation water to the lower valley from a proposed international reservoir near Falcon. The cost of the two projects would be $130,000,000. Bureau engineers W. W. Hall and E. L. Weathers at Corpus Christi added that actual work on the projects cannot begin for some time.

About $117,000,000 would be repaid by water users over a period of 40 years and the remainder charged off to flood control, fish and wildlife conservation, recreation and power.

SANITARY NEWS SUMMARY

Pollution of drinking water in several Florida communities has been reported recently by state health engineers. David Lee, chief engineer of the state Board of Health has made a tour of east coast cities, but a lack of personnel prevents complete survey of the problem. Communities affected have been advised to enforce a boiled water restriction to avoid disease . . . In Detroit, Mich., divisions of General Motors are spending $700,000 to end pollution of Flint River by oily waste and cyanide from the many plating processes . . . Paper mills on the Androscoggin River in Maine are adding sodium nitrate to the stream in an effort to deodorize the mill effluent. It is expected that the oxygen content will be sufficiently raised to prevent production of obnoxious gases . . . At Indianapolis, Ind., the Board of Sanitation will license privately owned garbage dumps. Meanwhile New York City's Department of Sanitation received approval of an 800-ton incinerator to cost $4,000,000 and sought funds for others . . . Officials of the Federal Security Agency and the Federal Works Agency on Aug. 11 completed preliminary plans for a national water pollution control program. It is estimated that the program ultimately will involve construction of sewerage systems and plants to cost more than $3,000,000,000. . . . Projects costing millions of dollars are being carried out in Virginia to cure pollution of streams supplying reservoirs . . . Upon direction of the Sanitary Water Board of Pennsylvania, a survey of the Juniata River will start next month. A similar survey of the Schuylkill River is now under way, and still another is to be made of the Clarion River and its tributaries.

Appoint advisory group to aid basing-point study

A congressional committee last week announced the appointment of a 41-member advisory council to aid the Congressmen in their study of the effects of the U. S. Supreme Court's action in outlawing basing-point pricing systems in the cement industry.

The court action (*ENR* May 6, vol. p.671) prohibits absorption of freight costs by producers, as a means of meeting competition with cement plants located nearer the consumer. This decision, with subsequent actions by the Federal Trade Commission against brick and steel manufacturers, has already forced an abandonment of the system by most suppliers of construction materials, and has started an upward spiral of costs to consumers.

Sen. Homer E. Capehart, chairman of the Senate Committee on Trade Policies, said the new advisory committee would study effects of the court decision, and report its findings to the Senate group.

American Standards Assn. enlarges scope of work

On Aug. 2 the American Standards Association became the American Standards Association, Incorporated, under the laws of the State of New York. This is the third in a series of changes which have recognized the enlarging scope of the association's work.

Organized in 1918 as the American Engineering Standards Committee—a co-ordinating committee for the standardization work of five important technical societies—the scope and organizational setup were soon broadened to include associations and government agencies. This led to extension of the work into the field of safety standards.

In 1928, an entire reorganization took place, changing the committee into a full-fledged "American Standards Association," a clearing house for standards and the U. S. medium for international contacts on standardization. The present change to an incorporated association gives the organization and its members the protection and benefits which corporation law affords. Bills seeking federal incorporation are now before Congress.

Frederick R. Lack, vice-president, Western Electric Co., is president of the incorporated group. Vice-Admiral G. F. Hussey, Jr. (USN, ret) is secretary and administrative head.

New posts opened to Frederick Snare officers

Arthur W. Buttenheim, for 21 years president of the Frederick Snare Corporation, contracting engineers of New York, has been elected chairman of the board and George P. Seeley has been appointed president to succeed him. Also announced is the election of Harry O. Ware, as secretary and treasurer.

Mr. Buttenheim, who fills a post that has been vacant since the death of Frederick Snare several years ago, has been with the Snare firm since its organization in 1900 under the name of Snare and Triest, Inc. Many notable structures, particularly those relating to port and harbor developments have been completed under his direction both in this country and in Latin America.

Mr Buttenheim also is a vice-president of the Pan American Society, president of the Colombian American Chamber of Commerce and has been active in the work of the National Foreign Trade Council.

Mr. Seeley, the new president, has been with the firm since shortly after his graduation from Princeton University in 1909. Following several years experience as superintendent of construction on projects along the eastern seaboard he became manager of the company's operations in Cuba. Here an organization was developed to handle a wide variety of work in Central America, the West Indies and South America.

Then followed a long period of residence in Peru where Mr. Seeley supervised extensive improvements at the port of Callao and directed other construction contracts. More recently he has been located in New York as vice-president and chief engineer.

At present the corporation is engaged on construction projects in Cuba, Colombia, Ecuador, Chile, Peru and Puerto Rico.

Fabian Bachrach photo

Conway Studios

G. P. Seeley (left) and R. W. Buttenheim who take new posts in engineering firm

Reclamation faced with fund shortage

The spectre of another shutdown of western reclamation projects arose last week to haunt Congress just after it left Washington. In a letter to Congressional Appropriations Committee chiefs, Interior Secretary Krug asserted that all available funds probably would be exhausted for two Missouri Basin jobs before the close of the calendar year.

Unless additional funds are made available, Krug added, construction money will run out for the Boysen Dam, Wyoming, around November 15, and for Angostura Dam, South Dakota, a month later. All appropriations will be exhausted on the Heart River project, north Dakota, late this year or early next, he estimated.

The Krug letter aroused immediate protest in Republican Congressional quarters as a pre-election political maneuver. Rep. Ben Jensen, chairman of the House subcommittee on interior appropriations, sent a sharp reply to Krug, advising the Reclamation Bureau to abide by the "spirit and letter" of the Interior Appropriations Act for fiscal 1949. He pointed out that this measure provided a total of $54,786,650 for Reclamation Bureau work on Missouri Basin projects.

To keep pace with construction schedules of contractors on the job an additional $4,965,850 will be needed for the Boysen project before the end of the fiscal year, Krug estimated. Requirements for Angostura amount to $1,200,000, and $750,000 for Heart River, he said.

Reclamation Commissioner Michael Straus told a McGraw-Hill representative that the bureau would make "every effort" to avoid closing down any projects "during the current calendar year." The bureau is investigating the possibility of transferring funds from other Missouri Basin jobs, he said, but this would pose one main problem.

First, both the House committee and the House-Senate conference committee on interior appropriations issued reports specifying amounts to be spent on each Missouri Basin job. Any transfer of funds would upset these estimates, Straus said.

Chlorinator monopoly charge dropped

A U. S. District Court at Providence, R. I., last week had dismissed "without prejudice" an anti-monopoly suit filed by the U. S. government as a civil action against six corporations and seven individuals charging monopolies in the production and distribution of chlorinating equipment.

The court held that the government had failed to produce any facts or evidence in support of the complaint.

Brought under the Sherman Anti-Trust Act, the action had been filed against Wallace and Tiernan Co., Inc.; Wallace and Tiernan Products, Inc.; Wallace and Tiernan Sales Corp.; Novadel-Agene Corp.; Industrial Appliance Corp; all of Belleville, N. J.; the Builders Iron Foundry of Providence; and individual officers of the several firms. A four-count indictment charged conspiracy to restrain trade, and an attempt to monopolize gas chlorinating equipment.

Investigation of a news item carried in *Engineering News-Record* in its issue of May 20, 1948, on volume page 746, indicates that that item was in error in that it implied that the suit had been filed recently. A check with the office of the United States Attorney General showed that the suit was actually filed after grand jury action in Providence in November, 1946, and that the case had been tried some time ago, and was held up pending a court decision.

The news release that formed the basis of the *ENR* story in May was submitted to this journal through normal mail channels, written on what purported to be an official release-form of the office of the U. S. attorney general. Later investigation proved the "release" was actually a copy of an announcement issued by the attorney general more than two years before.

LABOR ROUND-UP

Increases up to 25 cents an hour have been obtained by union carpenters in *Nevada* and central *California*. . . . *N. Y. State* Mediation Board disposed of 813 cases in the first half of this year. . . . Government figures show that wage rates of 7 union building crafts have risen higher in *Louisville, Ky.* than in 24 other north-central cities . . . Agreement has been reached in a dispute between building trades and a contractor on the $11,000,000 expansion of the Chesapeake and Ohio Railway yard at Worthington, Ky. . . . Strike of Buffalo, N. Y., ready-mixed concrete truck drivers entered its second month recently as contractors operated their own mixing plants . . . Construction work on the state armory at Barbourville, Ky., was halted as pickets protested employment of out-of-town laborers.

Agency formed to guide development of Northwest

Interests which favor a unified promotion program for the Pacific Northwest but oppose the creation of a Columbia Valley Authority have recently approved plans for the creation of a private agency, to be known as the Pacific Northwest Development Association, which will speak for the region on public questions involving federal and state government policies and programs.

Separate American and Canadian units will deal with their purely national problems while joint sessions would promote a coordinated program.

Judge Robert W. Sawyer of Bend, Ore., former president of the National Reclamation Association, presided at the first meeting of the group in Spokane, Wash. The new committee will be composed of five or more representatives from each of the four northwestern states and ten from British Columbia. Membership will represent reclamation and flood control interests, inland waterways, railroads, soil conservation districts, fish and game interests and lumbering and mining associations.

J. D'Esposito retires, Chicago subway engineer

Joshua D'Esposito, federal project enginneer of the Chicago subway, July 31 retired from federal service, upon reaching the retirement age of 70. He was in charge of the Chicago subway construction project since it was started ten years ago.

Maj. Gen. Philip B. Fleming, Federal Works Administrator designated U. F. Turpin, Evanston, Ill., Mr. D'Esposito's first assistant, to succeed him as project engineer. Charles W. Seymour, Hinsdale, Ill., becomes assistant project engineer.

Mr. D'Esposito had charge of the construction of Chicago's present union station and of other buildings on the Chicago waterfront. He started his career as a draftsman for the Pennsylvania Railroad in 1904, rising to the post of assistant to the chief engineer in 1913 at the age of 35, when he was put in charge of the Chicago terminal.

After completing the Union Station project in 1925, he went into private practice until 1933 when he was appointed Illinois state engineer for the Public Works Administration, transferring the following year to head the Chicago sanitation project.

In 1941 he was given an honorary degree of Doctor of Engineering by the Illinois Institute of Technology.

OBITUARY

R. A. Muenster, associate resident engineer of the Texas State Highway Department at Belton, died there on July 29. He was educated in civil engineering at the University of Texas.

Otto Milburn, 64, president of the Rockford Construction Co., Rockford, Ill., builder of city and rural highways for many years, died Aug. 2.

John A. C. Brookfield, a civil engineer, formerly of Halifax, N. S., died in Eire, July 25, while vacationing. He had been in engineering work in the British Isles for several years.

W. L. Turner, 86, retired civil engineer and land surveyor, died in Birmingham, Ala., Aug. 3. He was connected with the land department of the Sloss-Sheffield Steel & Iron Co. for many years.

William M. Paxton, 64, formerly city engineer of Florence, Ala., died there Aug. 3. He was a civil engineer graduate of Washington and Lee University.

Joseph M. Murray, 49, who for 25 years was engaged in highway construction in New York State, died Aug. 4 in Rochester. He opened his own contracting business in Rochester in 1923.

Reynolds D. Wilson, 64, a construction engineer with E. I. du Pont de Nemours and Co., died Aug. 7 in Wilmington, Del. He had been with the company since 1923.

James P. Ewin, 57, Mobile, Ala., construction engineer who built New Orleans' Sugar Bowl stadium, died Aug. 8 in Mobile. He was president of J. P. Ewin, Inc., one of the largest construction and engineering firms in the South. Recently, he had been supervising a $5,000,000 expansion of the Mobile docks, construction of a stadium in Mobile, and several other large projects.

James Murray, 82, vice-president, director and Cleveland division superintendent of the Great Lakes Dredge and Dock Co. died in Cleveland July 13. He had retired six years ago.

Raymond F. Leonard, 40, executive director of the City Planning Commission, Philadelphia, Pa., died there Aug. 9. In 1931 he received a master's degree in city planning from Harvard University. He joined the planning staff of the Tennessee Valley Authority in 1933 and stayed till 1937 when he became head of a National Resources Planning Board, covering six southeastern states. He had taken over technical direction of the Philadelphia Planning Commission only last May 16.

Guy E. Conkey, head of the 70-year-old construction firm of Hunkin-Conkey Co., Cleveland, Ohio, one of the largest construction companies in the United States, died Aug. 9. His company built the Ravenna Arsenal, the Cleveland Bomber Plant, the Duluth-Superior bridge, League Park, Cleveland Illuminating Co. building, Criminal Courts Building, and many dams, bridges and other structures for the government.

Frederick W. Baldwin, 66, a civil engineering graduate of the University of Toronto, formerly associated with the late Alexander Graham Bell and Glenn Curtiss in the Aeronautical Experimental Association, and the first Canadian to fly a heavier-than-air machine, died at Baddeck, N. S., on Aug. 7.

James Jackson, 55, assistant in the Sunnyside, Wash., office of the Yakima County Engineer, died Aug. 6 at Vancouver, Wash. A graduate of Washington State College, he served with the Army Corps of Engineers in France during the First World War and had been with the Yakima County engineer since 1920.

Harry N. Herr, 80, a civil engineer who in 1903 made the original survey for laying out Hershey, Pa., died in Lancaster, Pa., Aug. 7. He was a graduate of Lehigh University.

Plan $23 million office for accounting bureau

To be ready for bids this winter, and to be built as soon as feasible, a $23,000,000 air-conditioned 7-story building designed by the Public Buildings Administration for the General Accounting Office of the federal government in Washington will inclose nearly 1,000,000 sq. ft. of floor space. Block-type design without courts or wings will give maximum usable floor space within the limits of the site and provides large open areas for filing equipment and business machines.

Concrete frame with columns at 25-ft. centers on pile foundations will support flat slab floors to gain greatest net ceiling height and make it easy to run conduits and ducts.

The site for the building is on the block bounded by G, H, 4th and 5th streets N. W.

CONSTRUCTION ACTIVITY

CONTRACT VOLUME

Continental U. S. Only
(Thousands of Dollars)

	Week of Aug. 19	Cumulative	
	1948	1948 (34 wks.)	1947 (34 wks.)
Federal	$10,205	$672,850	$433,318
State & Mun.	51,521	1,667,933	1,107,221
Total Public.	$61,726	$2,340,783	$1,540,339
Total Private	55,420	2,171,406	1,934,115
U. S. Total.	$117,146	$4,512,189	$3,474,654

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

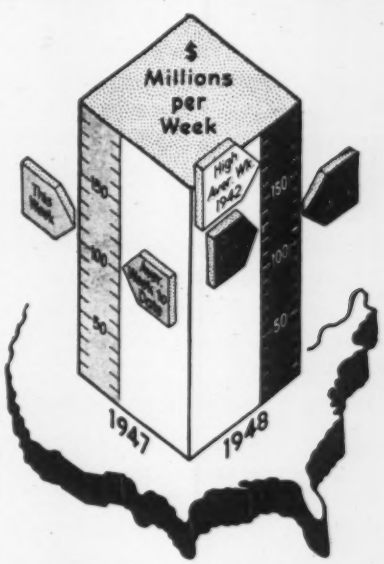
Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1948 (34 wks.)	Cumulative 1947 (34 wks.)
Waterworks ...	$3,920	$129,754	$71,937
Sewerage	11,219	149,583	87,563
Bridges	3,875	190,629	113,312
Highways	22,101	688,351	530,044
Earthwork, Waterways	850	338,450	197,386
Buildings, Public	15,898	699,240	367,307
Industrial ...	14,599	640,210	536,087
Commercial .	21,733	1,240,742	1,127,539
Unclassified ...	22,951	435,230	443,479

NOTE: Minimum size projects included are: Waterworks and waterway projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1948 (34 wks.)	Cumulative 1947 (34 wks.)
NON-FEDERAL	$3,266,736	$1,511,422
Corporate Securities	1,660,637	522,299
State and Municipal	1,178,810	741,412
Fed Aid Highway.	427,289	247,711
FEDERAL	1,558,932	818,729
Total Capital	$4,825,668	$2,330,151



As Reported this week to ...
Engineering News-Record

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	Aug. '48	475.51	228.58
Building Cost	Aug. '48	355.45	192.15
Volume	July '48	213	93

EDITORIALS

VOLUME 141 NUMBER 8

August 19, 1948

Heartening News from France

IN THESE DAYS when newspaper headlines are filled with depressing news from Europe it is heartening to learn that the rebuilding of the great ports of France is being pushed with vigor and that the French government is expanding and modernizing those ports so that they can handle more traffic than they did before the war. That can only mean that the French people at least are hopeful of the future and expect to rebuild and expand their foreign trade. The report in this issue on the port rebuilding program also indicates that this is not just a spending spree. Characteristic French frugality in the use of construction materials and skill in devising means to get the most out of each franc spent are everywhere evident. Against this brighter background the European picture does not seem to be as dark as the headlines might make it appear.

The Expanding Power Load

CIVIL ENGINEERS, along with the electricals and mechanicals, should be giving thought to the questions raised by the Edison Electric Institute's report that the peak load on electric power systems in this country grew from 30,800,000 kw. in 1940 to 49,550,000 kw. in 1947. The present expansion program will add 20,000,000 kw. by the end of 1951, at which time the peak demand is expected to have risen to 62,780,000 kw. Under these circumstances, and with atomic power still far in the future, it appears evident that most of the undeveloped waterpower sites within economic reach of power systems—such as the International Rapids of the St. Lawrence River—must be developed within relatively few years. Likewise, attention must be centered on more economical use of existing resources like those at Niagara Falls, as well as on others of lesser size whose effectiveness can be increased by additional headwater storage or even by pumped storage. In the meantime, and in view of the limited manufacturing capacity available for large turbines and generators, small-size hydro plants might well be built at some of the many available and undeveloped sites. Along with hydro expansion, it seems probable that much can be done in the way of more efficient use of the fuel now being consumed in old thermal stations to the end that each pound of fuel produces the maximum amount of power. Only by constant attack on all fronts can our power supply keep up with the demands of our expanding economy.

Recruits for Highway Departments

VIRGINIA'S Department of Highways has just issued a pamphlet that should be of material help in getting young people to consider highway work as a career. The pamphlet is not a recruiting document. Entitled "Towards a Greater Virginia", it is a well written and freely illustrated account of the state's highway system and of that system's importance to the development of the state. It is designed for use in the social studies classes in high schools, and for that reason, the effect of well built highways on the efficiency of the school system is stressed. Most of the pamphlet is given over to accounts of the various steps taken in the selection, design and construction of roads; and it is this part of the booklet that can be counted on to do the recruiting job. By skillful use of pictures to amplify the text, highway work is dramatized in a way that cannot but help stimulate students to give serious thought to training for work in the highway field. Other highway departments could profitably follow Virginia's example. In view of the large amount of highway work that is in sight for many years to come and the current shortage of engineers in the highway departments, it is obvious that recruiting needs to be planned on a long-time basis.

Waste Treatment for Industry

ONE of the distinguishing features of many new industrial plants is provision for collection and treatment of liquid waste. The time is past when industries can solve their waste-disposal problem by building a sewer to the nearest watercourse. Stream-pollution abatement requirements today make it mandatory for industry to put as much emphasis on provisions for handling wastes as it does in devising new production layouts.

This philosophy finds most recent expression in the ball-bearing plant of the New Departure Division of the General Motors Corp. in Sandusky, Ohio. As described on p. 91, design of waste-handling facilities for the wide variety of metal-working

operations carried out in this factory was a complex problem. How the various elements of the problem were defined, analysed and then intergrated for solution provides a fine example of the specialized thinking that must be applied to industrial-waste processing. Not the least interesting part of the solution was the decision to develop a chemical-treatment system that could be operated either continuously or on a batch basis.

While the design of the New Departure waste-treatment facilities was specifically adapted to requirements of that plant, the principles employed in making that design are widely applicable to every industrial-waste problem.

Strong Protest Needed

THE WAY in which the Civil Aeronautics Authority set out to get the engineering work done for two big airports in Alaska calls for the strongest possible protest from the engineering profession, for several reasons.

Requests for bids for engineering work on new airports at Anchorage and Fairbanks were sent by the CAA office in Alaska to a number of engineering firms known to be experienced in airport work (*ENR*, July 29, p. 3). These firms were instructed to make their proposals on a standard government construction-contract bid form, which requires a bid bond, performance bond and liquidated damages. Only the sketchiest sort of information as to the area in which the work was to be done was supplied, and the time allowed for submission of bids was so short that bidders unfamiliar with the region would have had to fly men to Alaska to make a reasonably accurate proposal.

The excuse given by the CAA for use of the construction-contract proposal form is that it is simple, can be completed quickly, and conforms to all decisions of the Comptroller General. Also, the CAA officials said that its performance bond requirements would protect the government against failure by inexperienced engineers to perform under the contract and also would keep bidders from "losing their shirts" if they ran into unforeseen difficulties.

There can be no excuse for adding the cost of bid and performance bonds to the cost of engineering work. In effect, what the CAA officials did was to pass to bonding companies their responsibility for determining what firms were qualified for the work —all at a considerable increase in cost to the government. It hardly seems possible that the Comptroller General would approve of that.

There are even more serious aspects of this bid call that cannot be overlooked. By requiring bid and performance bonds the CAA almost automatically eliminated most of the engineering firms who were well qualified to do the work, because most consulting engineers will not submit proposals under such conditions. At the same time it eliminated most of the firms whose standing and experience is such that they have no need to add the cost of those bonds to their bid price to insure against loss of their shirts.

Further, firms outside Alaska were given less than 20 days in which to submit proposals on the work at Anchorage and no information concerning the site or proposed airport was placed on file in the CAA headquarters in Washington. The CAA office in Washington explains that this is due to decentralization of its activities. Decentralization carried to that point cannot but be costly to the government.

In fairness to the Civil Aeronautics Authority it must be assumed that all this was done with the single purpose of getting construction of the airports under way at the earliest possible moment. But as a guide for the future it should be pointed out that exactly the same procedure could be followed if it was desired to give the job to a favored firm or to limit the bidding to local engineers in Alaska while appearing to call for competitive bids on a nation-wide basis.

It should be added that the engineering profession itself is in part responsible for this unfortunate happening due to its failure to evolve and get widespread approval of a system of submitting proposals that can be used by an agency like the CAA when it wants lump-sum proposals from engineering firms that can be weighed against the qualifications of each firm to do a particular job. So long as the profession refuses to recognize and formalize the competitive situation that everyone knows exists, it can expect inexperienced government agencies to do what the CAA office in Alaska did in this case.

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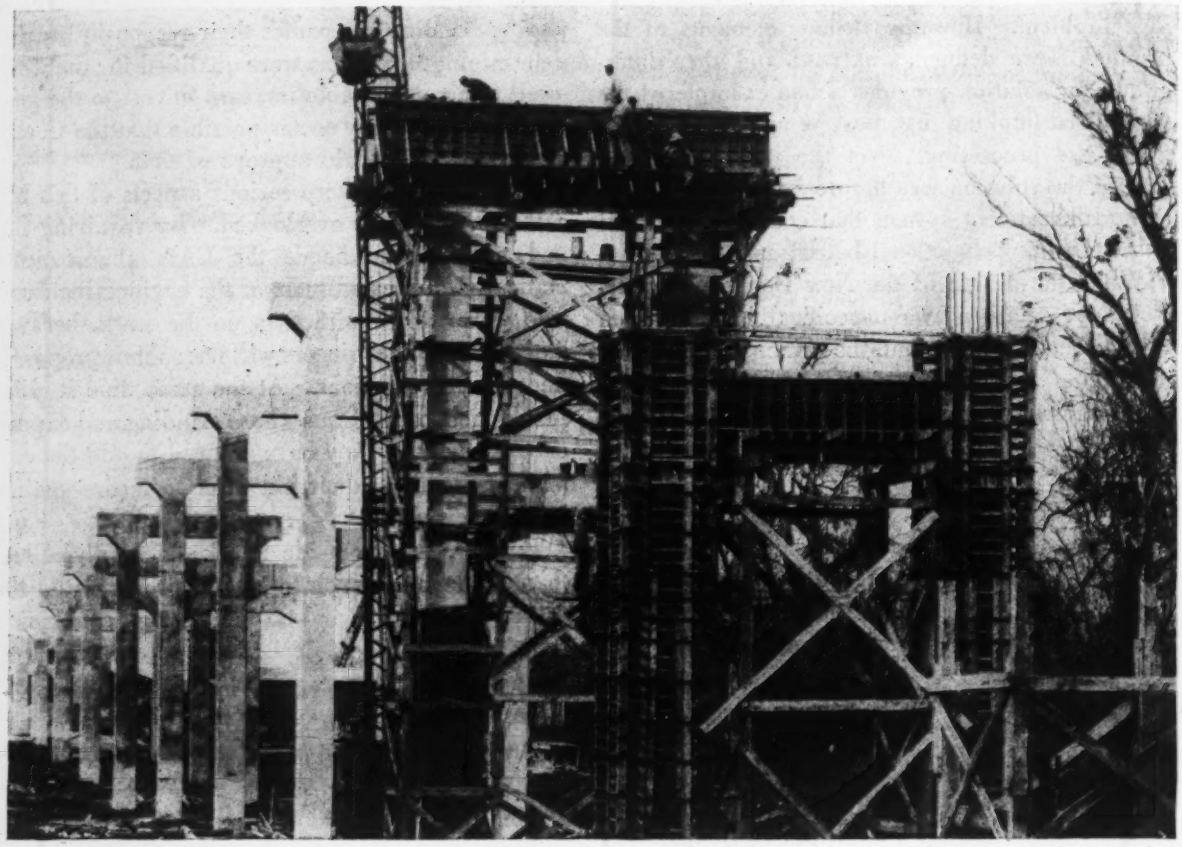


FIG. 1. TALL BENTS will carry the 60-ft. "articulated" stringer approach spans of the new Yazoo River bridge.

Truss-and-Beam Bridge Spans Yazoo River

NOW UNDER CONSTRUCTION over the Yazoo River on U. S. Highway 61 is a bridge that combines three-span conventional 864-ft. continuous trusses, with 1,560 ft. of rolled-beam and plate girder approach spans, incorporating what is termed an "articulated" design.

This design, in general, provides that one end of each roadway stringer is suspended from the cantilevered end of an adjoining stringer. The other end of the stringer in question cantilevers a short distance beyond its supporting bent to carry the suspended end of the adjoining stringer.

Chief advantages of this system are (1) the need for only single bearing and masonry plates for each line of stringers at each bent, (2) elimination of sliding friction at expansion ends of stringer and (3) slight reduction of positive bending moment due to the cantilever. At the same time, the cantilevered length of stringer is kept short enough to avoid adding cover plates for negative moment over the bent.

Other innovations include an 18-in. width curb for emergency walkway each side of the 26-ft. roadway, cast-in-place concrete handrail on the approach spans, with no portion of a post extending above or inside of rail. Handrails on the truss spans are single 8-in. channels set 18 in. above a stepped curb.

Trusses span up to 334 ft.

The 864-ft. continuous trusses, designed by the method of elastic weights, have spans of 270–324–270 ft. Trusses are cambered for full dead load plus vertical curve of finished grade line, and designed for 18,000 psi. in tension. Allowable unit compressive stress equals 15,000 — $\frac{1}{4}$ (l^2/r^2). Panel lengths are 27 ft., and trusses are spaced 32 ft. 6 in. c. to c. Floor beams are 33-in., 200-lb. wide-flange beams, while five lines of stringers spaced 6 ft. 3 in. apart are 24-in., 76-lb. beams.

Approach spans, numbering 24 in all, include a 98-ft. deck plate girder, with one 12-ft. cantilever at each end of the trusses; one 80-ft. stringer span followed by fifteen 60-ft. stringer spans on the north approach, and an 80-ft. span and five 60-ft. spans on the south. These span lengths are nominal and include length of cantilever—5 ft. 7 in. for the 60-ft. spans.

The bridge is designed for H-20 live load. Concrete, specified for a 3,000-psi. minimum strength at 28 days, is designed for unit working stress of 1,000 psi., with reinforcing steel at 20,000 psi.

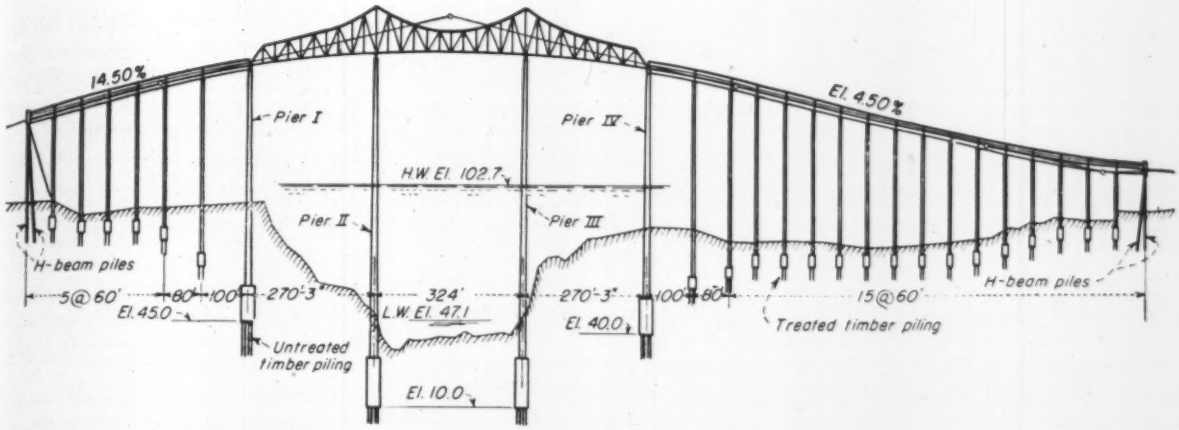


FIG. 2. TWENTY-FOUR APPROACH SPANS and four river piers carrying 864 ft. of continuous trusses make up a new highway bridge under construction by the state of Mississippi over the Yazoo above Vicksburg.

End bents are stub abutments with curved wings, each carried on eleven 12-in., 53-lb. H-beam piles—seven under the bridge seat and four under the wings. Piles are 75 ft. long, driven to a 35-ton resistance. Three piles under the bridge seat and the two wing-end piles are battered 3-in. per ft. to take the earth thrust.

One pile at each abutment was tested to twice the design load, with a permissible 48-hr. settlement of ¼-in.

Bents under the approach spans are two-column, varying in height from 27 to 90 ft. All are carried on treated timber piling driven 60 ft. into the underlying fine-to-coarse sand and pea gravel and to a 20-ton resistance. As the bents increase in height, tie-beams are added between the two columns. Four piles in each cluster are battered 2 in. per ft. parallel to center line of roadway.

Piers 1 and 4, under the ends of the continuous truss spans, are 100 and 105 ft. high, respectively. Pier caps are 38½ ft. long, 6 ft. wide and 5 ft. deep at the centerline of roadway. Bottom surfaces of the caps are curved. Columns are 6 ft. square at the top, battered ⅜-in. per ft. in all four directions, with corners chamfered in increasing amount toward the bottom of column. A web-wall, connecting the two columns extends to within 39 ft. of the top of pier. Piers have single plate footings 60½-ft. long, 30½-ft. wide and 15 ft. thick (in-cluding a 4½-ft. seal) and each pier is carried on 288 untreated timber piles spaced 2 ft. 6 in., each way. None of these piles is battered.

Piers 2 and 3, carrying the intermediate truss reactions are the same as Piers 1 and 4 except they are 140 ft. high, and footings are 20 ft. thick, including a 9-ft. seal.

Deep-seated fault under old bridge

The new bridge will replace a 20-year-old narrow structure located at a bluff a short distance upstream. Part of the old bridge has suffered progressive failure during the past seven years.

The cause of this unusual failure is a deep-seated fault in the underlying strata of Glendon limestone which are laminated with layers of marl, and overlay silts, clays and fine sand. This fault was aggravated from year to year by high waters of the Yazoo River, which eroded the soft material, resulting in mass slumping of the river bluff at the bridge site.

The south end of the old bridge was landed in the bluff, which is steep in profile and about 200 ft. high from stream bed to summit. The main steel trusses were connected with the bluff by timber approach spans supported on framed tower bents. Initially movement appeared only superficial and the first corrective measures involved driving a number of timber piles in the affected area. This proved unsuccessful and it became necessary to reconstruct the timber approach with full-length piles driven to refusal at considerable depths below the ground surface.

About two years ago this sliding and slumping intensified to such an extent that the pile bents were displaced and again caused failure of the timber approach spans. About 100

TABLE OF CONTRACTS, CONTRACTORS AND UNIT COSTS

Contract I (Approach Spans Complete):
Contractor: Foster & Creighton, Nashville, Tenn.
Construction Supt.: R. E. Gains
Contract Price: $430,000
Major Contract Items: Excavation, 3,890 cu.yd. @ $4.00; Concrete, 3,160 cu.yd. @ $46.50; Structural Steel, 1,335,300 lb. @ $0.12; Reinforcing Steel, 442,200 lb. @ $0.086; Cast-in-place Concrete Railing, 3,120 lin.ft. @ $5.47; Creosoted Foundation Piling: 21,700 lin.ft. @ $2.00.

Contract II (Four River Piers):
Contractor: Gordon Walker, Baton Rouge, La.
Construction Supt.: Gordon Walker
Contract Price: $592,000
Major Contract Items: Excavation (includes cost of cofferdams), 11,550 cu. yd. @ $10.92; Concrete: 5,880 cu.yd. @ $53.54; Concrete Seal: 1,620 cu.yd. @ $44.64; Reinforcing Steel: 204,850 lb. @ $0.10; Untreated Foundation Piling: 46,080 lin.ft. @ $1.26

Contract III (Continuous Truss Spans, exclusive of roadway slab):
Contractor: Virginia Bridge Co., Roanoke, Va.
Contract Price (Lump Sum): $287,000
Structural Steel: 1,026 tons

Contract IV (Roadway Slab on Truss Spans):
Estimated Cost: $53,000

Total Cost of Bridge Items: $1,362,000

Approach Embankment (1.9 mi.):
Grading (Contract Price): $125,000
Pavement (Estimated Cost): $100,000

Total Cost of Project: $1,587,000

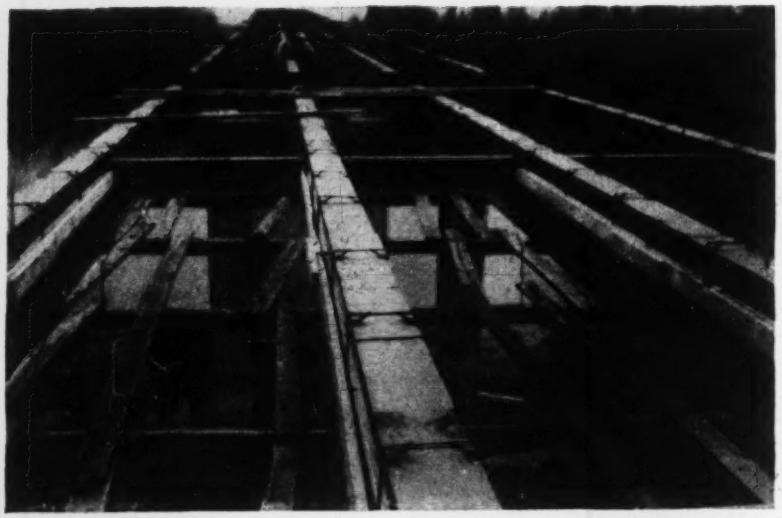


FIG. 3. CONTINUOUS DOUBLE LINES of 2 x 6-in. timbers hung by screw-anchors welded across top flange of stringers (at top) carry panelled roadway forms (at center) and knee-braced curb forms (at bottom). Job-made rig in center photo erects cantilevered curb forms.

ft. of concrete pavement at the bridge end was lost. It was apparent that proper repairs could not be made by ordinary means and without more definite knowledge of geological conditions. Comprehensive subsurface investigations were made, and the fault and cavities discovered.

It was further disclosed that the large concrete pier supporting the south end of the main river span was resting on a segment of the limestone formation lying on the riverside of the fault. Although this segment is now in at least a temporary state of equilibrium, it suggests great instability and is not regarded as a safe site for a new, permanent structure.

In view of these uncorrectable conditions, temporary repairs were made by spanning the faulted area with 200 ft. of Bailey bridge, and the old bridge site was abandoned in favor of a new location.

Four construction contracts

Construction of the $1,362,000 bridge is divided into four main contracts—the 24 approach spans with bents and abutments, $430,000; four river piers, $592,000; continuous truss spans, $287,000; and 865 ft. of concrete deck on the truss spans, estimated to cost $53,000.

Division of the work entails more field and office work on the part of the highway department, but it has two advantages: better contract prices could be obtained, and the contracts could be awarded to those experienced in the various phases of the work. The four river piers, for example, require special equipment and methods not needed on the approaches.

Construction of the river piers was started in July of last year and, despite a flood-caused two-month shutdown this spring, erection of the continuous trusses was scheduled to be started by Aug. 1 of this year.

Piers 1 and 4, located on the banks of the main channel are similar in design and methods of construction. Excavation is in open sheetpile cofferdam, with forms prefabricated on the job.

Piers 2 and 3 also are similar in construction, being built in open cofferdam of 70-ft. steel sheetpiling under about a 50-ft. head of water at normal river level. Timber trestle tramways built out from each bank of the main channel carry a fully-re-

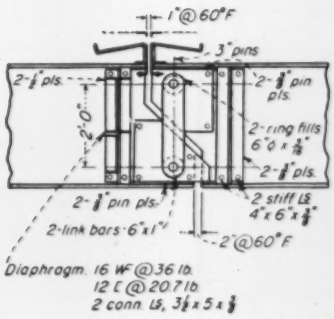


FIG. 4. STRINGER ENDS suspended from adjacent cantilevered stringer (at left), shown in detail at right, comprises the so-called "articulated" stringer system of approach spans.

volving eight-wheel crane for driving and removing sheetpiling, and for excavation, pile-driving and handling prefabricated forms. A barge-mounted crane assisted in piledriving and excavation at Pier 2.

All concrete in the four river piers will be pumped into place from a 2-cu. yd. mixing plant set up near Pier 1. A 6-in. concrete line will be extended across the river to Piers 2, 3 and 4 on steel pontoons, with provisions made for removing a central section to accommodate river traffic.

Excavation for bents of the approach spans was performed by clamshell in open cofferdams. Foundation piling was driven by a gravity hammer in swinging leads, operated by a crane with 61-ft. boom. Concrete for the bents was mixed in a 10-bag central mixing plant on either side of the river, trucked to the bents in ½-yd. buckets and elevated into the forms by a crane equipped with 80-ft. boom and 16-ft. jib.

FIG. 5. A 61-FT. BOOM CRANE operated a gravity hammer in swinging leads to drive piling for approach bents.

This rig also erected the roadway stringers—the full length of boom and jib being needed for the higher spans next to the continuous trusses. Concrete for the roadway on the approach spans will be pumped into place by a concrete pump machine located at either abutment.

Panel forms for approach deck

Formwork for the concrete roadway deck of the approach spans, although not as spectacular as some of the larger individual items in the bridge, is a striking example of simplification. The 1,080 ft. of roadway deck to be poured on the north approach, plus 480 ft. of deck on the south approach, offered an opportunity for economical construction through re-usable panel forms for supporting the roadway slab and curbs.

Approach spans contain four lines of roadway stringers, 7 ft. 8 in. apart, with curbs cantilevered 4 ft. 4½ in. past the centerline of the outside stringers. As the stringers were erected in place, light swinging scaffolding was hung about 3 ft. below stringers, supported by heavy wires looped over the stringers. This scaffolding will be left in place for stripping roadway deck forms, rubbing concrete and painting steel.

Patented screw-anchor supports welded across the top flanges of the stringers carry all formwork for the concrete deck. Short rods extend down each side of the stringers to carry longitudinal double lines of continuous 2x6-in. timbers which, in turn, carry the prefabricated roadway deck and curb forms. Flat washers at the bottom of these rods give ample support for the longitudinal timbers.

After the concrete roadway and curbs are placed, the anchor rods will be unscrewed from the top element and removed by workmen on the swinging scaffold. Forms for supporting concrete in the roadway slab and curbs are 2x6-in. timbers, transverse, decked with ⅝-in. plywood.

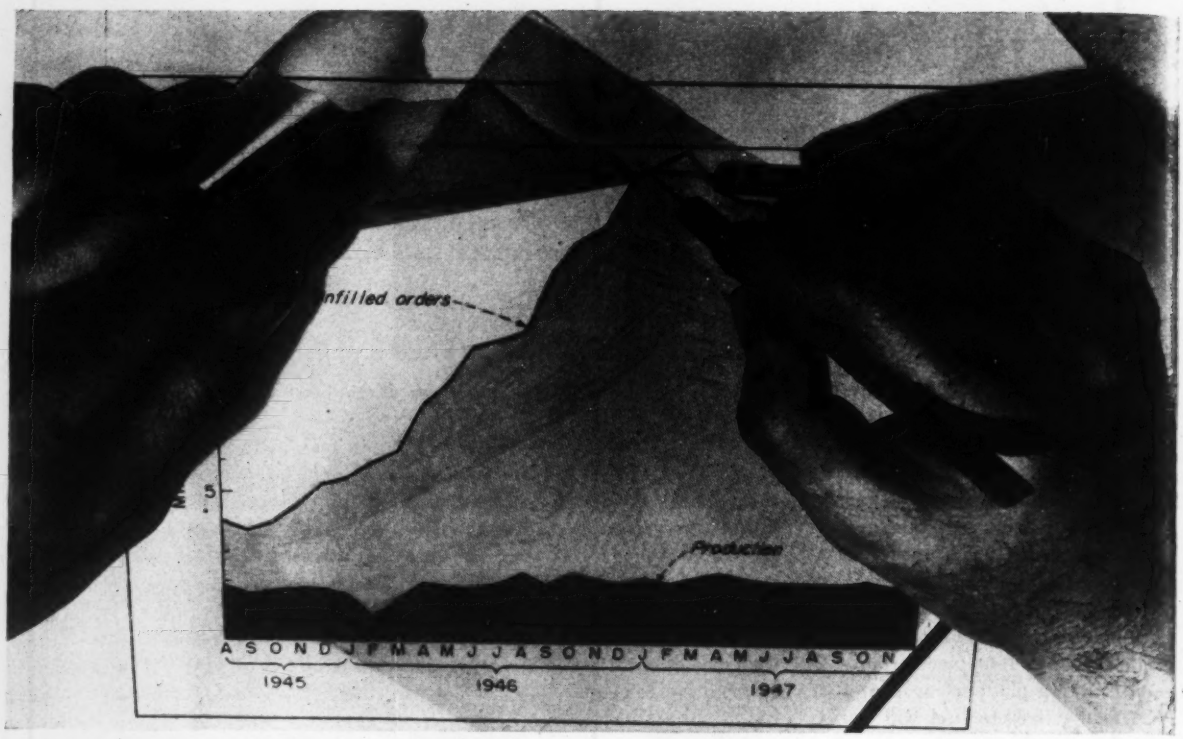
The cantilevered sections of these forms are knee-braced to the bottom flange of exterior stringers, with tie-back wires to the welded screw-anchor supports.

Roadway and curb forms were made in 3-ft. sections for ease in installation and removal. To insure ample working area for installing the forms, and placing and curing concrete, the contractor made up enough sectional forms to deck 250 ft. of bridge.

Approach spans are scheduled for completion by Sept. 1 and the entire bridge is expected to be completed by Jan. 1, 1949.

Engineers in charge

The Yazoo River bridge is being built as a federal aid project, under the direct supervision of C. S. Hill, bridge engineer, Mississippi State Highway Department, who also prepared the plans and specifications. R. A. Harris is chief engineer; E. W. Marley, district engineer and Geo. L. Lemon, resident engineer.



OVERLAY SCREENS, such as the stack sheet shown above, are a speedy means of obtaining drafting symbols on a tracing.

Hints on Effective Use of Reproductions

Maurice Grushky
Knappen Tippetts Abbett Engineering Co.
New York, N. Y.

PROPER use of the available methods of reproducing drawings is an indispensable factor in reducing drafting time and incidental charges in an engineering office. This applies to both original plans and basic layouts. Following is a brief description of the commonly used reproduction processes, recommendations as to where they may best be applied, and labor-saving suggestions.

In general, a reproduction may be classified either as a contact, a photographic or a plate print. In Tables I, II and III, respectively, are listed the types of reproductions included in these classifications, with a brief description of the final print and type of original required. The tables also give the usual maximum or standard sizes of prints, relative speed of reproduction, advantages of each process and normal uses.

BLUEPRINTS—To insure good prints, it is advisable to use a standard grade of tracing paper or cloth of uniform translucency. This permits the blueprint machine to be set and held at optimum adjustment to produce uniformly good prints for given conditions. When necessary, prints can be obtained even from heavy paper, if the opaque sheet is oiled.

Blueprinting to save time and labor

Calculations and bills of material may also be reproduced by blueprinting. The original should be on lightweight paper. When bond copy or second sheets are used, they should be carbon-backed (so that the typing appears on both sides) if clear blueprints are to be obtained. Small sheets in a set can be assembled on a standard-size sheet by means of cellophane tape, and printed as a single unit.

Usually, the blueprinter will trim and bind sets of prints when so requested, thus saving time and space in the drafting room.

Where symbols—such as cross-hatching, topographical designations over large areas, and boring logs—are desired, they can be obtained easily and quickly by using a cellulose overlay on which the symbols have been printed. The overlay screens are furnished in many patterns—positive, reverse and colored.

Positive screens are printed in black on a transparent background and reverse screens are printed in white. Colored screens are useful in exhibits where it is desirable to have a transparent overlay. Placed over the parts of the drawing to be shaded, usually on the reverse side to insure against removal in the printing proc-

TABLE I—CONTACT PRINTS

(Note: Prints same size as original. Maximum size generally 54 in. by any length. Normally printed and returned same day.)

Prints	Description	Type of Original	Advantages	Uses
Blueprints	White lines on blue field—paper or cloth	Tracing (paper or cloth) Transparentized opaque paper Vandyke positive Diazo transparencies Photolith Lithoprint	Inexpensive Do not show dirt marks	Most common form of reproduction Reverse prints
Blue lines	Dark blue lines on white field—paper or cloth	Kodalith Film negative Photostat negative Vandyke negative	Negative can be made to a changed scale or from an assembly of prints Portions can be opaqued and insertions made on all negatives New marks legible on white field	Where required type of original is available Inexpensive prints from photostat negatives For compact reports
Vandyke negatives	White lines on dark brown field—paper or cloth	As for blueprints	Portions can be opaqued and insertions made Do not fade	For making: Vandyke positives Blue line prints Photolithos
Vandyke positives	Dark brown lines on white field—paper or cloth	Vandyke negative Kodalith Film negative Photostat negative	Can be worked on with pencil or ink	Where type of original is available and a reproducible is required for making blueprints
Diazo prints	Black, Blue Brown or maroon lines on white field—paper or cloth Other backgrounds possible	Tracing (paper or cloth) Vandyke positive Photolith Lithoprint	Relatively inexpensive New marks legible on light field Prints close to the original scale	Opaque prints with white field directly from tracing Transparencies for record reproducibles or for alterations Reverse prints

ess, the screen is rubbed until it adheres to the drawing and then trimmed to the desired shape. When the same legends or notes are to be repeated frequently on tracings, it is well to print them on acetate films, which can be rubbed onto the tracings.

At times it is desirable to have some lines on a print appear less conspicuous than others—for example, the contour lines of a map on which a proposed structure is to be shown. This may be done by using light blue, navy blue, or diluted black ink. Where it is desired to show an item conspicuously; for example, to ring up a revision on a tracing, yellow marking should be used on the reverse side.

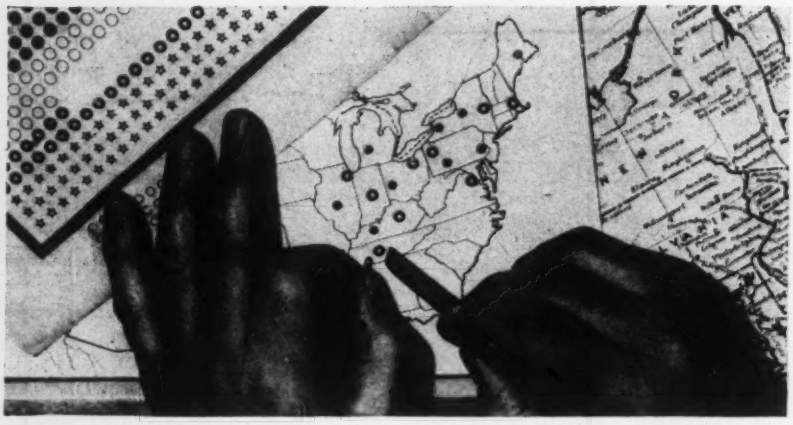
BLUE LINE PRINTS—Made in the same manner as blueprints, these reproductions can be made considerably smaller than the original, for insertion in reports by reducing the size of the negative. Since the cost of this type of print is less than that of photostats, it is advantageous in

TABLE II—PHOTOGRAPHIC PRINTS

Prints	Description	Type of Original	Size	Relative Speed of Reproduction	Advantages	Uses
Photostats: Negatives	White lines on black field—paper.	Any copy having white background.	Standard: 8½ x 11 in. 11 x 14 in. 14 x 18 in. 18 x 24 in. Giantstat: Over 18 x 24 in. to 40 x 72 in. (Usually). Reprostat to 59 x 96 in.	Normally printed and returned same day. 24 hours. 24 hours.	Printed directly on paper. Portions can be blocked out. Faint lines reproducible. Sharp details. Yellow and green can be filtered out.	For making: Photostat positives. Blue line prints. Record prints. Reflected views.
Positives	Black lines on white field—paper.	Photostat negative. Blueprint. Film negative. Kodalith. Vandyke negative.	As above.	As above.	Can be made to a changed scale or from an assembly of prints. All listed above, except for assembly of prints. Portions can be toned down.	As above. Prints for coloring.
Photolithos or process tracings.	Duplicate tracing—paper or cloth.	Any original. The original determines type of negative used for making the photolitho; i.e., Kodalith, Vandyke negative, or film negative.	54 in by any length.	24 hours.	Can be made to a changed scale or from an assembly of prints. Portions can be blocked out. Weak details in original can be strengthened. Can be worked on with pencil or ink.	Duplicate of original tracing.
Microfilm	Cellulose acetate safety film.	Any original	8, 16 or 35 mm.	Same day.	Saves space.	Insurance against loss of originals. Record purposes.

TABLE III—PLATE PRINTS

Prints	Description	Type of Original	Size	Relative Speed of Reproduction	Advantages	Uses
Lithoprints	Ink reproduction—transparent or opaque—paper or cloth—black, red or blue ink.	Tracing (paper or cloth). Photolight. Lithoprint. Vandyke positive. (Opaque subjects require special handling).	Maximum: 54 in. by any length.	Printed and returned in 24 hours.	Substitute for an ink drawing.	For border lines, title box, etc. Limited number of copies.
Photo-offsets	Ink reproduction—paper or cloth.	Any original.	8¼ x 11 in. or multiples to 44 x 64 in. Max. generally 17 x 22 in.	One week.	Inexpensive for quantity. Scales can be changed.	Printed in quantity. Colored prints. Half tones.



DRAFTING TIME AND LABOR can be saved by using cellulose overlays on which symbols have been printed.

many cases to obtain extra-thin paper negative photostats and use them in ordering blue lines.

VANDYKES — Reversed vandyke negatives when reproduced on blueprint paper will give sharper blue lines on white background than the ordinary direct-reading negative. Brown lines on a positive vandyke may be removed with corrector fluid when desired, but the use of this liquid should be limited, since it does not remove the unwanted parts permanently.

DIAZO PRINTS—These include black and white, ozalids and helios, having black, blue, brown or maroon lines, generally on white. The white background is advantageous in the preparation of design drawings: in the case of a print showing the outline of a concrete structure, the designer can designate the reinforcement in pencil on the white background for transference to the tracing by a draftsman.

Diazo transparencies may be used when original tracings are not available or when it is required to show design changes without altering the original. Reverse printing permits the making of all corrections and revisions on the unprinted face of the transparency with pencil or ink before removing the unwanted parts with corrector fluid.

Photographic Prints

PHOTOSTATS—For economy in obtaining positive enlargements, the smallest standard size negative possible should be ordered and the enlargements made from the small negative. Unless the size of the negative is specifically designated, both the negative and the positive photostats may be enlarged, with a corresponding increase in cost. For example, in the case of an 8½x11-in. original to be increased 100 percent, the lowest cost would be for an 8½x11-in. negative and 17x22-in. positive. In the case of a 17x22-in. positive photostat required from the original of the same size, it might be advisable to obtain negatives with a 50 percent reduction—or 8½x11 in.—and then make positives by enlarging 100 percent from the negatives. It is advisable to draw graphical scales on plans that are to be enlarged or reduced.

Portions of a photostat can be toned down and sometimes removed by the use of a reducing agent. This is done after the print is fixed but before it is washed and dried.

By means of a mirror, reflected views are obtainable in photostats. Of course, the lettering on such prints will have to be corrected.

Several kinds of photostat paper are available. Glossy paper is desirable where much detail or contrast is important. When water color is used on glossy paper, even results may be obtained after the prints have dried by soaking them in water and passing them through a dryer. Matte-surface paper is most commonly used because it costs less and lines can be drawn on it with more facility. Extra-thin matte-surface paper is best for making blue line prints.

PHOTOLITHOS OR PROGRESS TRACINGS—Work can be performed on process tracings as on ordinary original tracings, except that erasures should be made with a dampened eraser. After the lines are loosened, they may be wiped with a damp cloth or wad of cotton. The dampened eraser will not score the surface, and changes can be made in the same spot without deterioration of the cloth. Care must be used not to break the thin coating on the cloth, which is impossible to restore.

Since the production of process tracings is a photographic process, light does not pass through the original copy. Consequently, all lines and markings should appear on the exposed surface. The lines of a process tracing are heavier than those of the original, and unless absolutely necessary, a process tracing of a process tracing should not be made.

MICROFILMS—In microfilm work, it is very important to establish and maintain proper indices. Each roll should be indexed to show in proper sequence the drawing numbers of the drawing appearing thereon. Also, each drawing should be indexed to show the rolls on which the original and all subsequent revisions appear.

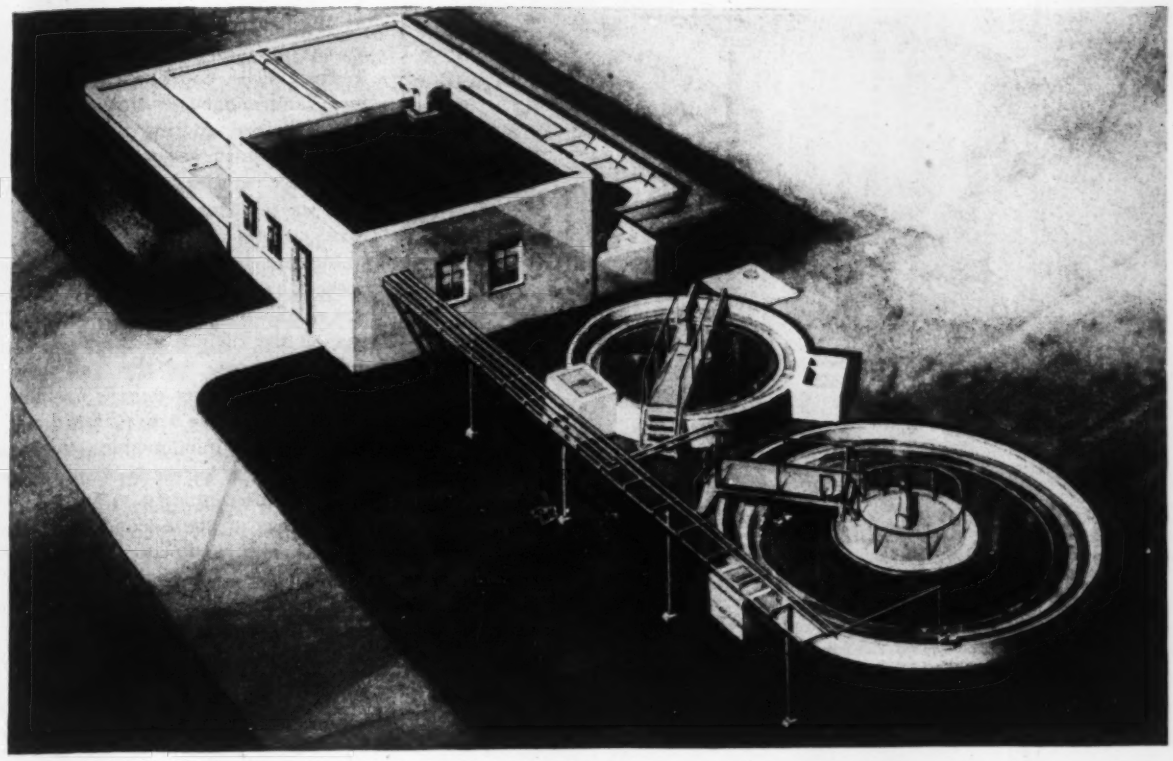
Plate prints

LITHOPRINTS—These are made by transferring the impression of a tracing to a gelatine-coated zinc plate by means of a special type of blueprint of the original. The impression on the plate is inked and copies then struck off. Where contracts require the submission of inked cloth tracings, lithoprints generally qualify.

Lithoprints are commonly used for standard sheets with inked borders and title box.

PHOTO-OFFSETS — These involve the use of photography in the preparation of a plate that picks up the ink and transfers it to a rubber roller, which, in turn, is applied to the paper or cloth. Offset printing is a process frequently used for reproducing maps and forms in quantity. Scales can be changed when preparing the plate. Colors can be shown by this process.

Generally, two or more processes may be used in any situation, and the determining factors in selecting the most advantageous process are quantity, purpose or quality, type of original, cost, time element and equipment limitations. Therefore, in every engineering office, there should be at least one person who is thoroughly familiar with the possibilities, limitations and characteristics of all the processes.



FACILITIES for chemical neutralization and sedimentation furnish the means for . . .

Treating Metal-Working Wastes

Design of the New Departure ball-bearing plant provided opportunity for integration of manufacturing operations with collection and treatment facilities to handle a complex variety of liquid wastes

Harry D. Unwin
Member, Albert Kahn Associated Architects & Engineers
Detroit, Mich.

A SIGNIFICANT trend in industrial plant design today is the incorporation of facilities for the treatment of liquid wastes prior to their discharge into sewers or waterways. Illustrative of this situation are the provisions made for industrial-waste disposal at the ball-bearing plant completed last year at Sandusky, Ohio for the New Departure Division of The General Motors Corporation.

Here the problem was one of special complexity, concerned as it was with a great variety of metal-working operations. In this plant, the 563,000 sq. ft. manufacturing area contains ten different points of origin for liquid wastes, including: Ball shop, press room, machinery department, heat treat, grinding, pickling, chrome-plating, laundry and dry-cleaning, forge shop and miscellaneous operations. All of this pointed to the necessity for suitable collection and treatment facilities to be integrated with manufacturing operations in considering the layout and design of the new plant.

The first step, therefore, was an analysis of the type, quantities and characteristics of each form of waste. In general, it was determined that the primary sources of waste originated with alkali-cleaning machines, pickling of steel, chrome-plating and renewal of coolant make-up tanks. Miscellaneous operations contributed insoluble oils (quench, mineral seal, hydraulic and cutting types) and emulsions of various kinds.

Development of an overall plan for handling the wastes involved questions of economical treatment methods coupled with flexibility of collection and processing. Of major consideration were the economical benefits to be derived from utilizing waste pickle-liquor to "crack" emul-

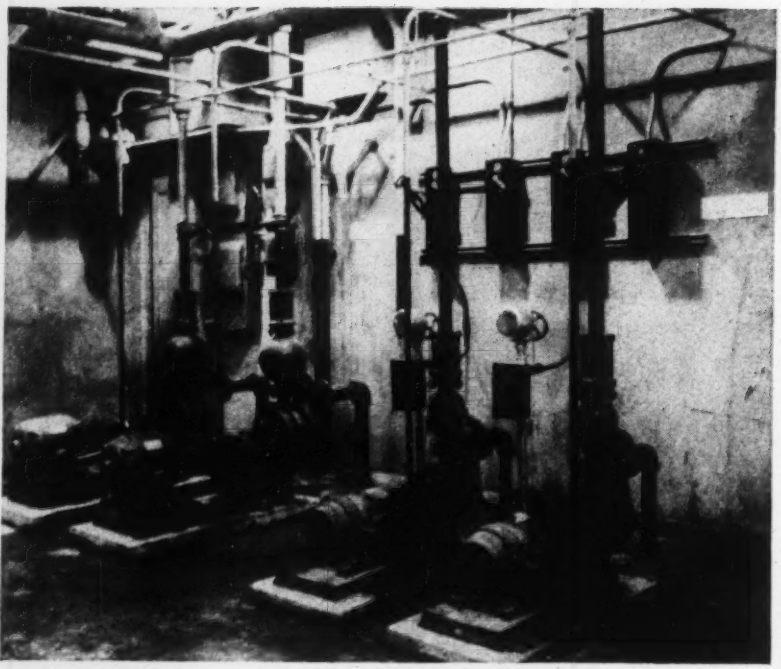


FIG. 2. ALKALI AND ACID SUMP PUMPS. These units operate automatically to transfer the wastes to the storage reservoirs over a 24-hr. period so that treatment plant operation may be restricted to 8 hours daily.

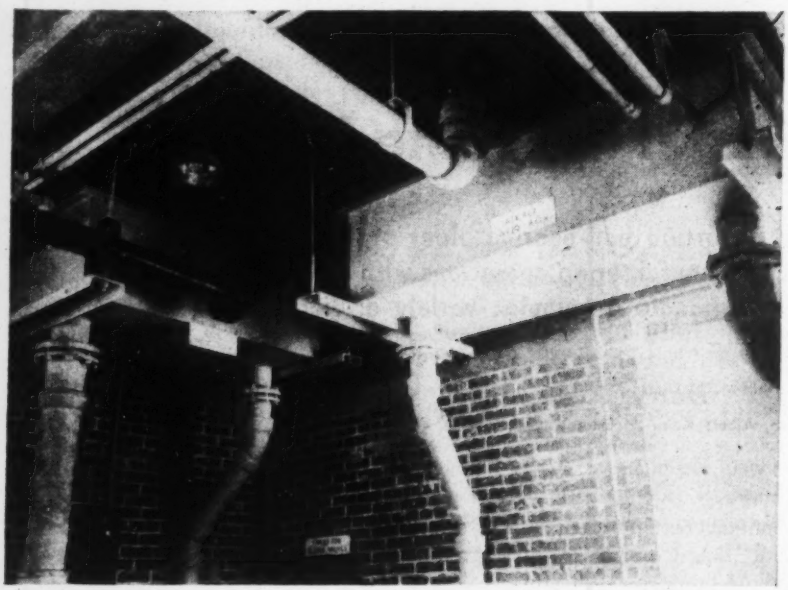


FIG. 3. ALKALI AND ACID WEIR BOXES are located near the first-floor ceiling of the pumphouse. The black line to the acid weir box is Saran acid-resisting pipe with hard-rubber fittings. The discharge and overflow lines are high-silica, cast-iron pipe. Similar lines to and from the alkali box are steel and cast iron.

sified soluble oils that are present in the alkali wastes.

In order to determine maximum allowable concentrations of various wastes permissible in the discharge from this plant, the Ohio State Department of Health was consulted. Requirements that they established applied only to this particular plant since each problem is considered with respect to the plant location and the point of waste discharge.

The plant discharge is in Mills Creek, which has practically no flow at certain seasons of the year. Any increase in flow represents stormwater discharges, effluent from a small sewage disposal plant and process wastes. Mills Creek winds through farm land and passes through a golf course before entering the Sandusky municipal storm sewer system, which ultimately empties into Lake Erie.

It was evident, therefore that any toxic wastes entering the stream would not be sufficiently diluted to prevent harm to grazing cattle. Also, any soluble oils discharged would collect on the surface of the stream in quiescent areas in the golf-course area. Such oil not only is unsightly but it can become a fire hazard, particularly if inflammable cleaning agents such as kerosene or other solvents are present.

In view of these conditions, the Ohio health authorities established the following maximum concentrations of objectionable substances permitted in the plant stormwater discharge:

Chromium	2.0 ppm.
Emulsified oils	30.0 ppm.
Suspended solids	20.0 ppm
pH range	7.0-10.0

Character and composition of wastes

Wastes were classified according to their composition and source of origin as follows:

Weak Alkalis—These wastes include all of the rinse waters from the washing machines and plating department, lime-dip tank discharge, oily wastes from the steam-cleaning room, insoluble waste oil, laundry discharges, and the contents of the alkali-cleaner tanks of the washing machines, when found too contaminated for satisfactory operation.

Spent Pickle-Liquor—This is material that has developed too high an iron sulfate concentration for efficient scale removal. It was grouped separately in order to study its relationship to the alkali and soluble oil wastes.

Acid-bearing Waters—These include sulfuric-acid rinse from the pickling machine and the chromic acid rinse from the plating and Parkerizing systems. They were grouped together as weak-acid wastes for further analysis.

Coolant-Discharges—These emanate from the central coolant system in emergencies or as required for maintenance purposes.

It was found that the amount of spent pickle-liquor discharged weekly

would assist the weak-acid waste to neutralize the weekly quantity of soluble oil, lime and alkali-cleaning agents (which comprise the weak-alkali waste), as well as crack a reasonable amount of soluble oil from the make-up tanks if this should be required. It appeared economical, therefore, to segregate the pickle acid for use in the treatment process.

Also, it was decided to separate the concentrated waste coolant and thus prevent large quantities of this waste from upsetting the normal character of the weak-alkali group of wastes. Since the weak-acid waste also contains chromic acid, this likewise was segregated to reduce the quantity to be treated for chromium reduction.

Total estimated flow of all wastes, for 150 per cent peak load, contained the following contaminants:

Alkali as Na_2O	1,500 ppm.
Sulfuric Acid H_2SO_4	3,900
Ferrous Sulfate Fe SO_4	2,200
Chromium	3
Soluble Oil	2,300
Insoluble Oil	650

If the plating department should be operated without benefit of diluting rinse waters from the pickling machine and alkali-washing machines, there would be a possible chromic acid concentration of 20.9 ppm in the rinse water. By the same reasoning, the rinse water from the pickling system would have a concentration of 43.7 ppm. Furthermore, if the soluble oil tanks on the various machines, isolated from the central system, were dumped during a shutdown period, the concentration might be 20,000-30,000 ppm. or higher.

Comparing these possible and probable concentrations of wastes with the requirements as set forth by the Ohio state health department for discharges into Mills Creek, it was evident that suitable treatment methods were required.

Waste collection problems

Wide variations in flow rates and degree of contamination of individual wastes are not conducive to an economical control or treatment system. This led to a decision that the wastes be impounded in reservoirs prior to their introduction into the treatment plant, thus achieving more uniform composition as well as controlled rates of flow. For this purpose waste-collecting systems are provided—one for acid and one for alkali wastes.

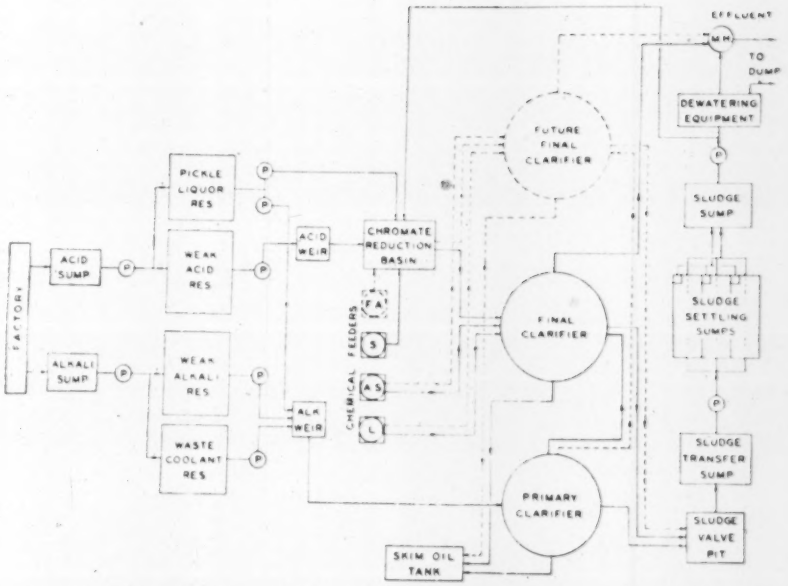


FIG. 4. FLOW DIAGRAM showing all the plant units and the way in which they are connected. Treatment involves four stages: (1) primary clarification; (2) chromate reduction; (3) final clarification; and (4) sludge dewatering.

Alkali Collection—This system consists of overhead piping in the roof-truss space of the plant. Into this all alkali and oil-bearing wastes are pumped from sumps located at the metal-washing machines, from the lime-rinse tank of the pickling machine, steam-cleaning room, alkali waste sump in the plating department and at other production equipment where liquid wastes originate. Both rinse waters and concentrated alkali wastes pass through this system to the receiving reservoirs. When the discharge of the coolant make-up tanks becomes necessary, it is scheduled at a time when little or no alkali-rinse waters are flowing so that this concentrated waste may be impounded separately.

Acid Collection—This system receives the gravity discharge of spent pickle liquor and acid-rinse waters from the sulfuric-acid pickling of strip coils and from the chromium-plating operation, which are considered as permanently located departments. Pickling liquor is scheduled for dumping at a time when the sulfuric and chromic-acid rinse waters are not flowing so that it may be impounded separately and held in reserve as a useful, low-cost treatment chemical.

With this arrangement for collecting the wastes, a minimum of piping is required, maximum flexibility is provided and at the same time the four major types of wastes—weak alkali, weak acid, pickling liquor and spent coolant—are properly segregated and made available for treatment and neutralization in any desired proportion.

Design basis for treatment

Five methods of disposal were analyzed in connection with the design of the treatment process. These included: (1) disposal by dilution; (2) disposal by discharge into the sanitary sewage-treatment works; (3) disposal by settling and aeration; (4) disposal by evaporation; and (5) disposal by chemical treatment.

The fifth method was chosen. The chemical-treatment process was found to afford a high degree of flexibility, since flow rates of raw wastes and treatment agents can be controlled. It also permitted wide ranges of concentrations to be handled as well as being adaptable to the treatment of additional wastes with little or no change to the mechanical equipment. Furthermore, a chemical-treatment method may be operated continuously or on a batch basis, labor and power costs are at a minimum and the system can be made automatic if desired.

Design of the plant was based upon handling 150 per cent of the estimated peak flow of wastes over a 24 hr. period—a total of 125,000 gal. of weak alkali and 85,000 gal. of

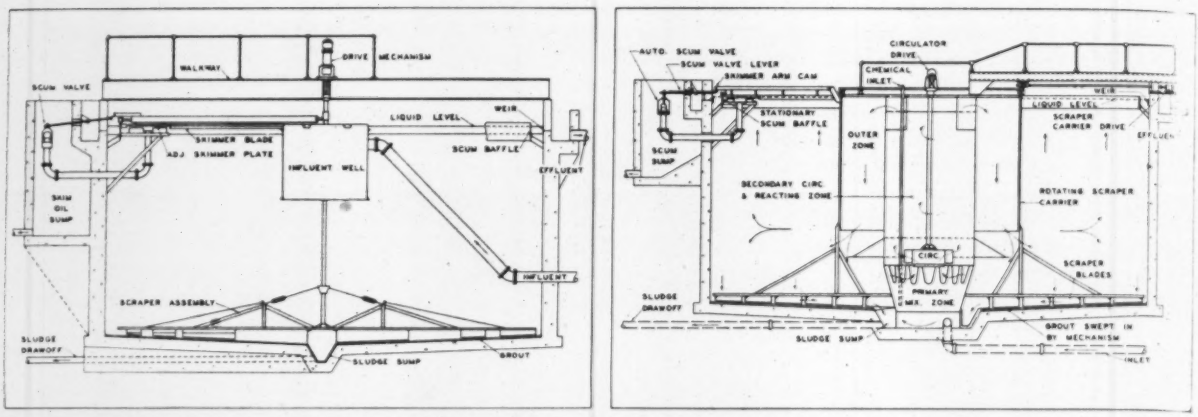


FIG. 5. PRIMARY (LEFT) AND FINAL CLARIFIERS are not identical in design. The primary unit, which is a conventional type widely used in municipal practice, is for oil removal. Design of the final clarifier is distinguished by a central inlet chamber containing a circulator.

weak acid. In addition, provision was made to impound 8,000 gal. of spent pickling liquor and several thousand gallons of waste coolant.

To reduce the operating-labor cost to a minimum, the rate of treatment and neutralization was established on the basis of handling the ultimate 24 hr. peak load in an 8 hr. operating period. Therefore, the system as originally laid out had a maximum design capacity of 440 gpm. Since the ultimate design load of 150 per cent of the present estimated peak requirements will not be reached for some time, one-half of the final clarification equipment has been omitted.

As presently installed, the plant will handle 75 per cent of the estimated peak load in an 8 hr. operating period, or 130 gpm. of alkaline waste and 90 gpm. of acid waste equivalent to 220 gpm. The economy of this is seen from the fact that the peak demand can actually increase to 225 per cent before additional clarification equipment need be installed, merely by increasing the operating hours of the treatment plant to 24 hr. if necessary.

Method of treatment

The treatment is accomplished in four stages:

(1) Primary clarification for partial separation and removal of soluble and insoluble oils;
(2) Chromate reduction to reduce the chromium in the weak-acid waste;
(3) Final clarification and neutralization; and
(4) Sludge dewatering and disposal.

The flow diagram (Fig. 4) shows the units and the way they are connected. The four storage reservoirs permit treatment to be carried on as a continuous process during the 8 hr. daily operating period. This arrangement has another advantage. When wastes are produced at a much slower rate than normal, they can be impounded until sufficient volume has been accumulated to allow a full 8 hr. operation of the plant.

Caustic waste from the weak-alkali reservoir is pumped through a controlled-level weir box to the 20 ft. dia. primary clarifier. To effect acidification and promote oil separation, a portion of the waste pickle-liquor is pumped to the weir box to mix with the alkaline waste.

In the primary clarifier, the pH is maintained at about 5.0 to 6.0 for maximum oil separation. The oil and some precipitated iron hydroxide separates as a floating scum, which is removed by an hydraulic skimmer and collected through a gravity line to an underground tank. Partly clarified soluble oil-bearing alkali waste discharges by gravity to the final clarifier where treatment is completed and neutralization effected.

When chromium is present in the rinse waters, a preliminary step is required to reduce the chromates from the hexavalent to the trivalent form. The weak-acid waste containing both sulfuric and chromic acid is pumped from the storage reservoir through a controlled level weir box to the rapid-mix or chromate-reduction chamber. Spent pickle liquor in excess of that required for oil separation also is pumped to this basin for disposal. At the same time, the ferrous sulfate content effects partial reduction of the chromium. More complete reduction of the chromates to trivalent chromium, prior to precipitation, is obtained by feeding a controlled amount of one of the stronger reducing agents such as sodium bisulfite or sodium hydrosulfite.

From the reduction basin, the treated weak-acid waste flows by gravity to the 30 ft. dia. final clarifier where lime is added directly to the reaction chamber, to effect neutralization and raise the pH to approximately 9.0 for better precipitation of the iron and chromic hydroxides.

Activated silica is also added to the agitated reaction chamber to improve coagulation and precipitation of the hydroxides. The activated silica broadens the effective pH range of coagulation and improves the coagulation, particularly during winter operation when the wastes are at a lower temperature; it has the further advantage of increasing sludge compaction.

Clarifiers and sludge handling

The two clarifiers are not identical in design since the function of the primary unit is oil removal while that of the final clarifier is precipitation and separation of solids. Sectional sketches of these circular units are shown in Fig. 5.

It will be noted that the primary clarifier is of the conventional design widely used in municipal sewage-treatment practice. The final clarifier, however, shows an important difference in the design of the central inlet chamber. Effluent from the primary clarifier along with the discharge from the chromate reduction chamber are blended prior to introduction

into the bottom of this inlet. Positive mechanical agitation is provided through a circulator which completely mixes the incoming liquid to be further clarified with the lime and activated silica. The design also permits some of the advantages to be obtained through partial recirculation of the slurry to more quickly and better prepare the solids for separation.

Sludge removal from the tanks is controlled by solenoid-operated valves actuated by individual timers for intermittent opening. Frequency and duration of discharge is made to conform with the rate of sludge formation in each clarifier. Discharged sludge is pumped to three settling basins, each having a capacity of 15,000 gal.

Supernatant liquor from the basins flows by gravity through an adjustable decanting pipe to a sump, from which it is pumped for disposal via the chromate reduction basin overflow to the final clarifier. After the supernatant has been drawn down to the visible sludge line in the basins, the basins are again filled with sludge. This sequence of operations is continued until the solids have been concentrated three to four times, after which the thickened sludge is pumped to a lagoon for dewatering and disposal.

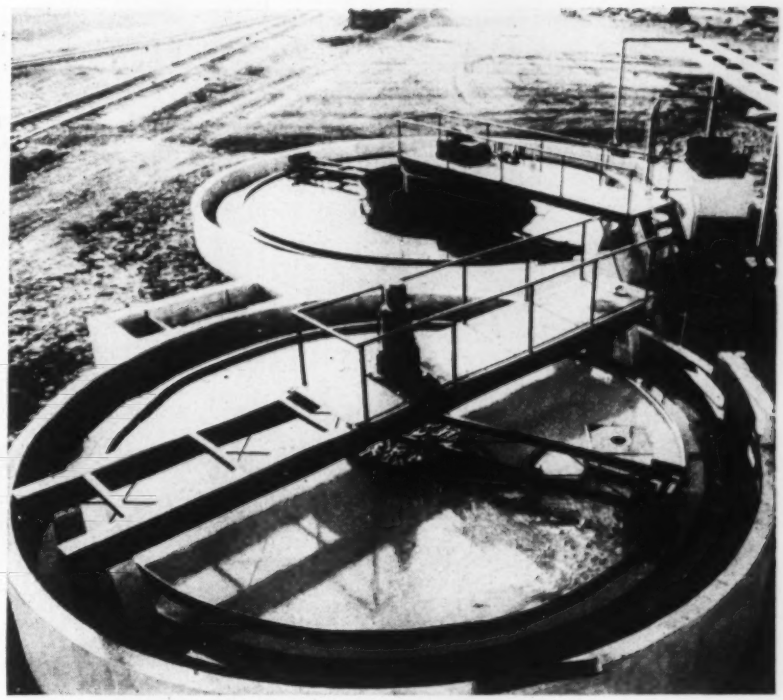


FIG. 6. CLARIFIER UNITS IN ACTION. The primary unit, in the foreground, skims off insoluble oils and emulsified coolants as they rise to the surface.

Operating experiences

Economic flexibility in the layout of any waste-treatment plant must provide means for adapting the facilities to reasonably wide variations in the composition of the wastes. The first few months of operation clearly substantiated the value of such practice. Chromium concentrations varied from 8 to 189 ppm. while the total oil content of the alkali waste ranged from 1,000 to 110,000 ppm. The final effluent, however, always analyzed below the concentrations established by the state authorities.

Minor piping changes were made to permit the use of the bisulfite feeder for adding ferrous sulfate to the primary clarifier for breaking the soluble oil emulsions and to the chromate reduction, or rapid-mix basin for chromium reduction. The changes that occurred may be summarized as:

(1) Partial reduction of the chromium in the acid waste and formation of ferric sulfate;

(2) High dosage to the primary clarifier released the soluble oil which was skimmed off;

(3) Primary clarifier effluent contained excess ferrous sulfate and ferrous hydroxide; and

(4) Combining of the reduction-basin discharge and primary-clarifier effluent in the final clarifier resulted in reduction of the chromium below the required limit when sufficient lime was added for precipitation of the metallic hydroxides and neutralization.

Recent reports of plant operation indicate that the character of the wastes are "normal;" that is, wide variations in analysis of the acid and alkali wastes are less frequent, and more uniform day-to-day concentrations of chromium and oil are being attained. Average analyses show:

Weak-Alkali Waste	
Alkalinity	150-400 ppm.
Total Oil	6,000-16,000 ppm.
Weak Acid Waste:	
pH	2.1-6.8
Mineral Acidity	150-1000 ppm.
Chromium ($Cr O_3$)	1-19 ppm.
Final Effluent:	
pH	9.2-10.6
Chromium	trace-0.2 ppm.
Total Oil	2-20 ppm.

Experience with the New Departure Division waste-disposal system validates these conclusions:

(1) Every possible method of control should be carefully investigated including reclamation, dilution or treatment at the source, segregation of wastes, and the many possible means of disposal.

(2) No single waste should be considered independently. The effect of other wastes and the probability of utilizing them to control or treat each other must be given serious analysis.

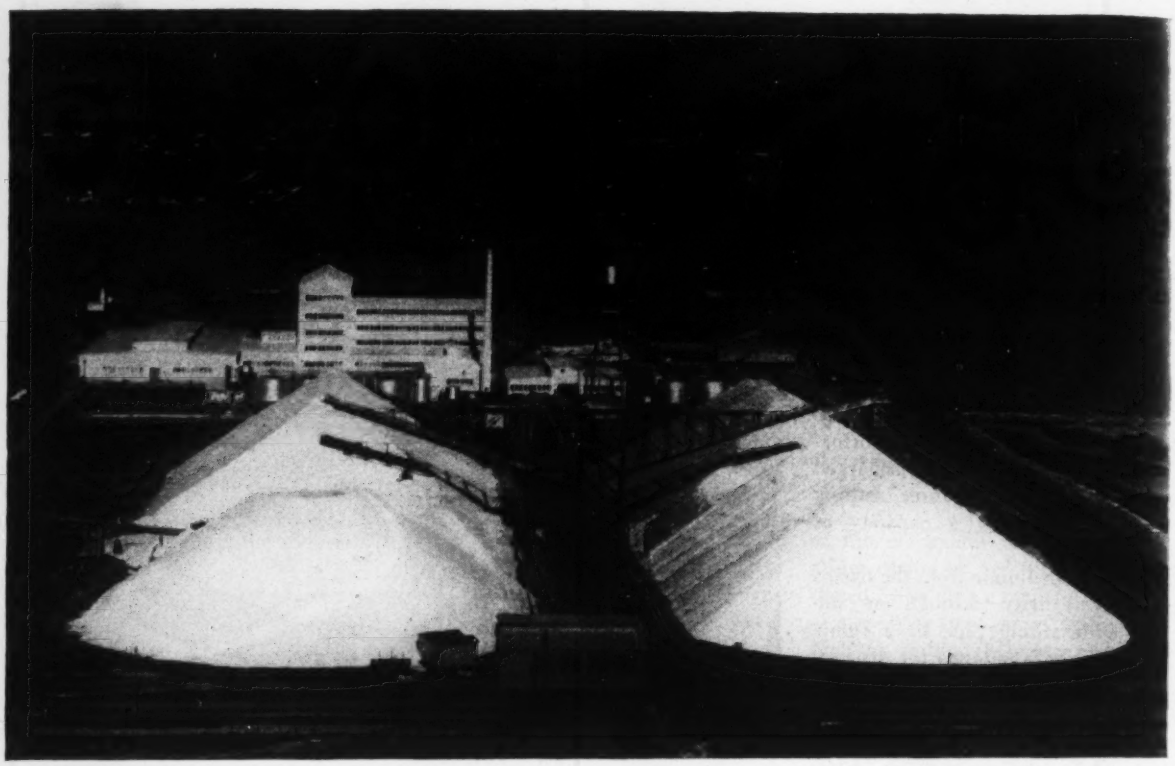
(3) Flexibility of waste-collecting systems and methods of control must always be borne in mind as changing production methods and utilization of different process liquids may easily make obsolete the entire waste disposal system.

Acknowledgment

Design and supervision of the construction of the industrial-waste disposal facilities by the Albert Kahn Associated Architects and Engineers was carried out under the general direction of the writer.

Contractors on the plant included: National Concrete Fireproofing Co., Cleveland, general construction; John Winkel, Inc., Larchmont, N. Y., mechanical work; and Miller-Brown, Inc., New York City, electrical work.

Clarifiers and chemical feeders were manufactured by Infilco, Inc., Chicago.



OPEN STORAGE SALT PILES, 90 ft. high, develop foundation loads up to 3 tons per sq. ft. For duplicate storage piles now being built nearby on soft bottom, design was developed to carry this load on subaqueous fill.

Subaqueous Fill on Soft Bottom Is Support for Raw Salt Storage

A NEW SALT STORAGE and shipping terminal now being built on the south arm of San Francisco Bay required provision for carrying heavy loads on the soft foundation characteristic of deep mud tideflats.

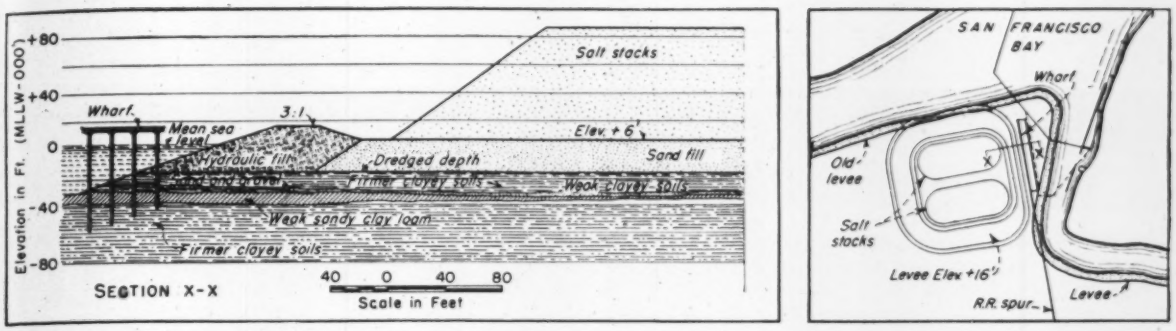
Under similar Bay foundation conditions, piles have been used exclusively for structures close to the water. But with the large area and heavy loadings needed for the salt storage, the cost of pile foundation would have been prohibitive—an estimate on concrete-topped pile construction was $8 per sq. ft. or a total for the project of $2,800,000. The orthodox program of using piles was therefore discarded at the outset and the design worked out made use of a sand fill with mud topping, at a total cost of $518,700.

The new storage and shipping facilities, being built by the Leslie Salt Co. near Redwood City, Calif., are an enlargement of operations, since a similar plant just across the bay is also owned by this same company. The older plant, where the company has its refinery, makes use of the same process for reclaiming salt from sea water that is planned for the new addition. This is a system of levees that converts large areas of tidal flats into evaporating ponds through which the brine is pumped in increasing stages of salinity as natural evaporation takes place. In the last stage, salt is precipitated in crystallizer ponds on carefully graded bottoms. A 4-in. layer of salt is periodically harvested from these ponds by tractor-mounted machines delivering to storage piles by tram cars and conveyor belts.

The objective in building the new plant—from which 90 percent of the product will be shipped out as unrefined industrial salt—was to stockpile the salt at a point whence it could be delivered directly to ocean-going ships as well as to railroad cars. The old plant is inshore and can ship only by rail. The problem introduced by locating the new storage piles close to deep water was soft mud that ranged to 40 ft. in depth in some locations. At the site chosen the mud is about 21 ft. thick, superimposed on a 10-ft. stratum of stronger blue clay which, in turn, rests on firm clay mixed with gravel.

On this foundation it was desired to provide for salt storage piles weighing some 300,000 tons and this foundation provision had to be such that an adjoining loading wharf on concrete piles would not be in danger of horizontal thrust or upheaval from the stockpiles.

As in the duplicate plant inland



PLAN of the new storage stacks from which shipment can be either by rail or water. Section through wharf and fills showing relation of imported sand and clay fills with respect to the concrete wharf.

provision had to be made for two storage piles, each to contain 150,000 tons of salt and each covering an area of 622x256 ft. This provides for salt stacked to a height of about 90 ft. at the crest of the pile. Footing loads resultant from such a stack are 3 tons per sq. ft. under the peak axis or an average of 1½ tons for the entire area. The stacks must be separated by 64 ft. at the base to provide room for a traveling crane that operates between them.

To reduce conveyor costs to a minimum it was desirable to locate the wharf as close to the storage area as practicable. Provision for rail loading, of course, would be made between storage piles and wharf.

Preparing the stockpile area

Part of the economy in the fill program arose from the fact that in the grading necessary at the site of the crystallizer ponds an estimated 1,370,000 cu. yd. of mud was needed. This mud, borings indicated, could be taken from the area where the salt stacks were to be located. A price of 17 cents per cu. yd. was obtained on a contract for removing mud from the storage area to the crystallization beds and this work, costing some $53,000 afforded an important credit item in preparation of the storage pile foundations.

Two storage piles were located in a roughly square area measuring 666x620 ft. Around this a levee was laid out to be pumped in, with a width of 80 ft., rising to El. +16, or about 10 ft. above the height of M.L.L.W. The function of this levee was twofold: to protect the storage area against tidal incursion, and through its weight to act as a counterbalance against foundation slippage such as might be caused by the great weight of the salt stacks.

After the mud had been removed from the salt stack area a contract was let for filling the hole with stable material. The most economical material was sand on which tests showed an expected consolidation of 1 percent and which could be delivered in place by a sea-going hopper dredge at a cost of $1.25 per cu. yd. Following completion of the sand fill the plan calls for covering the sand with a 2-ft. layer of mud, which, when dried, becomes a cushion between the sand and the salt, to make it possible to remove the salt without picking up any sand. Fine material, like mud, can be readily taken out of the salt in the brine washers, whereas sand, which will not dissolve, is much more difficult to remove.

Protection against horizontal thrust

With adequate provision for supporting the stockpiles, the next problem was to provide sufficient strength in the cross-section through salt stack and wharf. This, obviously, would be the weakest feature in the provision of storage at shipside. Ordinarily, requirements in this respect would be met by some form of bulkhead in which long sheetpiling would be supplemented by batterpiles.

An alternate to this orthodox solution of the problem was found in the use of more subaqueous fill, this time made of clay forming a full-section counterbalancing levee that could be relied upon to take horizontal thrust. Such a fill is being placed inshore from the wharf site by a suction dredge that first removed a slot of mud 90 ft. wide extending down through the soft material to the firmer clay beneath. This mud was used for the cushion over the sand fill mentioned in the foregoing.

Fortunately, clay suitable for the fill was available in the lower portion of the berth area that had to be dredged in front of the wharf. Clay from this source will be used to fill not only the slot but to carry the fill up at full cross-section to a height of El. +16 and to continue it on around the entire salt stack area.

This procedure protects the wharf area from thrust. The material is sufficiently stiff to be pumped into the slot without difficulty and to furnish adequate foundation for wharf auxiliary facilities, tracks, etc. The final process in foundation preparation will be to dredge the wharf site to depth and slope desired, just prior to actual wharf construction.

The new storage and shipping depot was designed by B. C. Alin, of San Francisco as consulting engineer for the Leslie Salt Co.; borings were made by the Raymond Concrete Pile Co.; laboratory check of soils and the fill loadings were made by Dames & Moore, San Francisco. Dredging was done by the Johnson-Western Co. and sand filling by the Construction Aggregates Corp.

ITEMIZED DREDGE-AND-FILL COSTS

Dredging from salt stack area (310,000 cu. yd. @ 17½¢ (used for fill elsewhere on job)	$ 52,700
Sand fill (310,000 cu. yd. @ $1.25)	387,500
Mud removal behind wharf (used to pave stack areas) (50,000 cu. yd. @ 25¢)	12,500
Clay levee construction (140,000 cu. yd. @ 40¢)	56,000
Retaining dike and contingencies	10,000
	$518,700

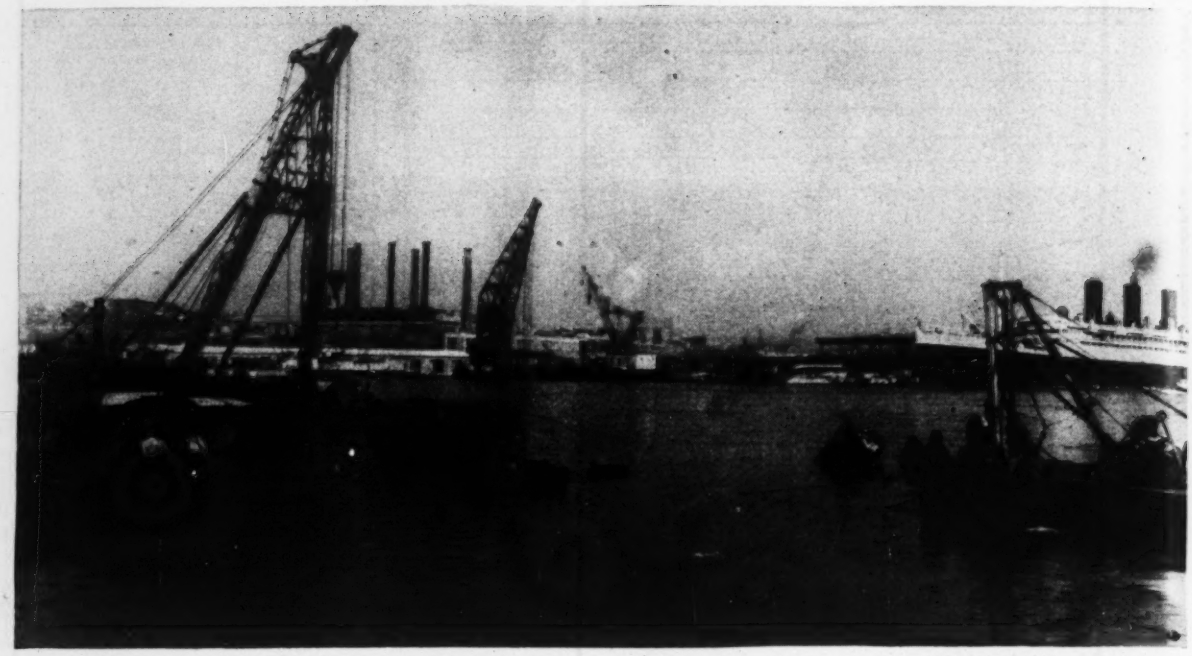


FIG. 1. PUMPS MOUNTED ON SMALL BOATS evacuate the water from compartments in a sunken ship preparatory to raising it. A floating crane stands by to render assistance and to service the divers. This scene in Marseille can be duplicated in every war-wrecked harbor of France.

France Rebuilds Her Ports

Waldo G. Bowman
Editor, Engineering News-Record

No French port of any size escaped serious damage in the war, but the three of most interest to Americans—because our Army Engineers and Navy Seabees performed the initial work of reconstruction—are Marseille, Le Havre and Cherbourg. This interest is heightened at the present time, because French port reconstruction is a vital element in the European Recovery Program. And there is added significance in the fact that these three ports occupy positions 1, 2 and 6 among the ports of France in tonnage handled since the war. Cherbourg, in addition, is a principal transatlantic passenger terminal.

Largely as a result of what our military forces accomplished, the ports of Le Havre and Marseille are today handling over 70 percent of their prewar tonnage, while at Cherbourg tonnage is 530 percent of its previous maximum, since it was largely a passenger port before the war. In actual figures, Marseille is operating at a 7 million-ton annual rate, Le Havre at 5 million, and Cherbourg at 1.3 million.

A visit to these ports last summer revealed that a surprising amount of the temporary American-built facilities provided to supply our armies, is still in use, and that much of it is serviceable for several years to come. In addition, since the end of the war, the French have extended the reconstruction to other parts of the ports, and have replaced some of the temporary units with permanent construction. This rebuilding has been fitted into modernization plans, drawn up for long-time development, so that eventually these ports will be more efficient and larger than they were before their destruction.

In the meantime, however, shortages of materials, manpower and money have slowed progress compared to a six-year rebuilding schedule drawn up at the end of the war. As pointed out in a special port reconstruction issue of the French magazine, *Travaux*, published in April, 1947, the fourteen major ports of France were estimated to require 200,000 tons of cement and 115,000 tons of steel in the first year of the program. While most of the cement was available, only 37,000 tons of steel could be obtained and, since prospects for increasing this tonnage were slim, as much as possible of the second year's program was redesigned to use concrete. In addition, arrangements were made to purchase some fabricated steelwork, particularly bridge material and basin and drydock gates, from England. These changes in plan permitted some speed-up in achievement in 1947, until strikes and the political and financial crisis again put on the brakes. In 1948, hopes for more sustained accomplishment reside in possible aid from the Marshall Plan.

What has happened since the war and what is planned for the future at Le Havre, Cherbourg and Marseille is the subject of this article.

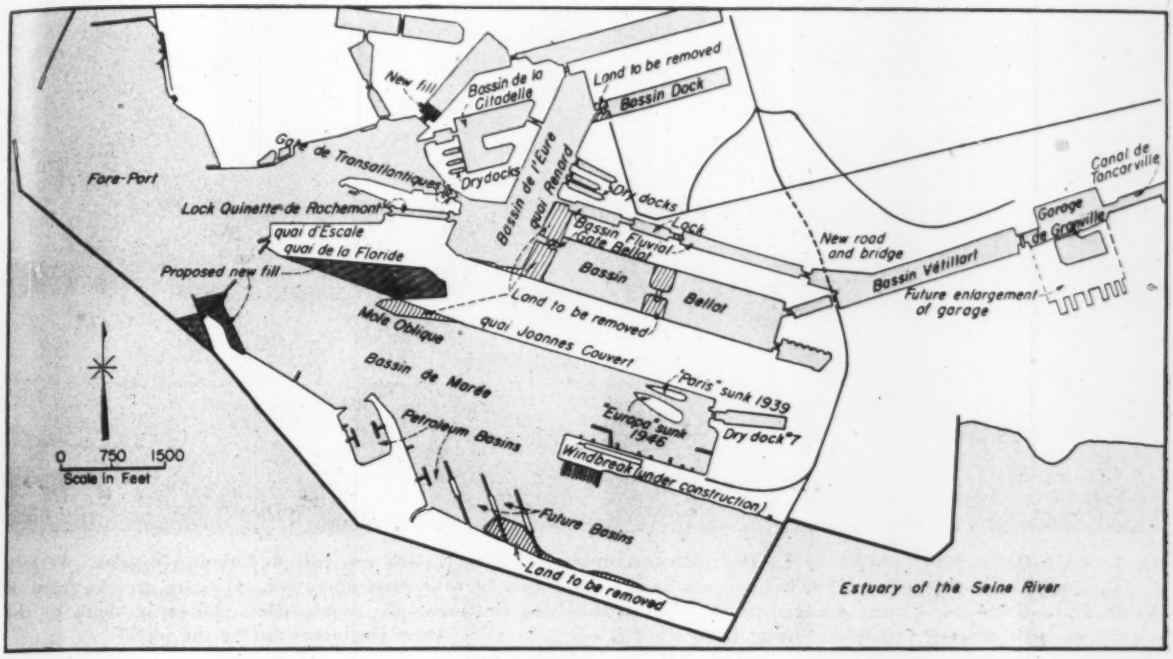


FIG. 2. THE PORT OF LE HAVRE, already equipped with an extensive layout of both natural deep-water quais and gate-protected constant-level deep-water basins, is working toward enlargement, extension and modernization of these facilities. Extensive dredging and filling are required by the future plan.

The Port of Le Havre

Three years after its liberation, the port of Le Havre appears quite different from the vast chaos in which it was left by the war. The clearing away of debris is finished; the terrepleins (large shore areas for open storage and the like) are cleared of all wreckage; and all seven drydocks of the port are in service.

The work of repairing the breaches in the quais has also been finished, including the permanent reconstruction of about 1,300 ft. of quais where deep-draft vessels can be moored. In all, including facilities built by the U. S. Army Engineers during the war, over 36,000 ft. of quais of all kinds are available for normal operation.

FIG. 3. UNIQUE ADDITION to Le Havre facilities is a windbreak, in the lee of which ships can be repaired. Resembling a dam spillway on its windward side, it will be 800-ft. long and 70-ft. high.

Numerous other signs of progress may also be noted. Most of the roads have been repaired, and 40,000 sq. yd. of new pavement has been laid. Three large bascule bridges have been entirely reconstructed, and all the basin gates that will not disappear in the plan of reconstruction of the port have been rebuilt. The main gate entrances to the port, however, are still undergoing repairs. Those in the Quinette de Rochemont lock are in service, but are in the process of being changed over from hydraulic to electric operation. The adjacent Gate de Transatlantique, whose leaves were pierced by German demolitions and plugged by the U. S. Engineers (*ENR* June 14, 1945 vol. p. 816) are still being worked on. (Fig. 4).

As to other facilities, 3,000,000 sq. ft. of warehouses and of other buildings have been reconstructed or repaired, and oil storage capacity of a million barrels has been restored. Handling equipment available includes 130 cranes, of which 30 are of floating type. A provisional sea terminal is in course of construction on the Quai Joannes-Couvert, and all entrances to the port have been cleared to 30 ft. depth at low water.

The most spectacular construction

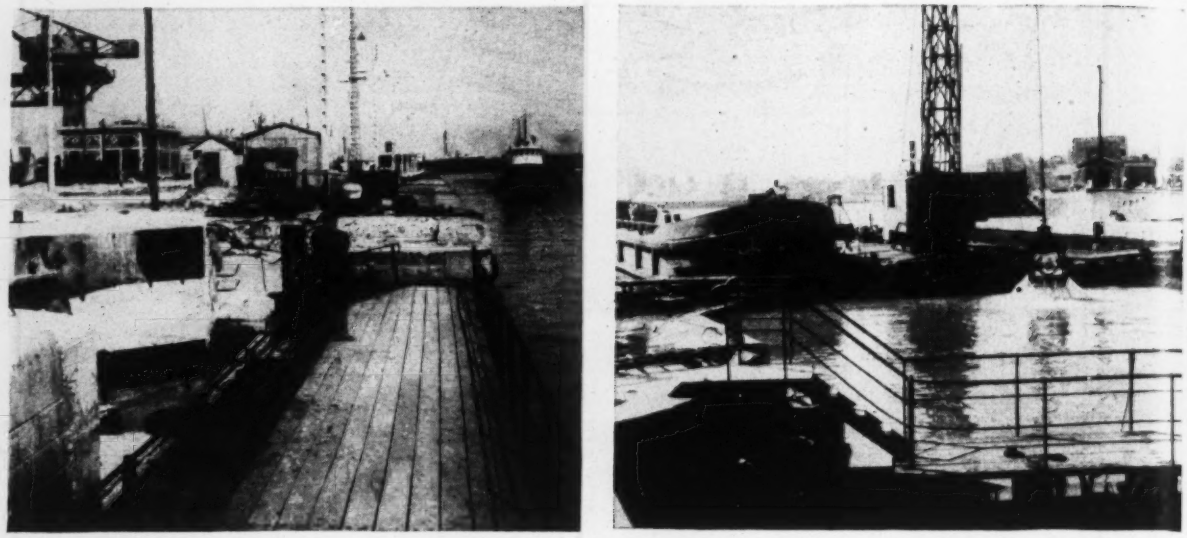


FIG. 4. MAIN-GATE ENTRANCES to Le Havre's constant-level docking basins are still undergoing repairs. At left, gate into Quinette de Rochemont lock is being changed from hydraulic to electric operation. At right, area in front of Gate de Transatlantique is being dredged preparatory to removing the leaves for repair. Holes blown in them by the Germans are now covered with plates hung from the top edges by U. S. Army Engineers during the war.

project in the port involves the building of a unique windbreak, in the lee of which ships can be repaired protected from the strong south winds that, in February, 1947, caused the liner Europa to break her moorings and sink, much to French chagrin and embarrassment. Some 70-ft. high and 800-ft. long, the windbreak resembles a dam spillway when viewed from the south, while its appearance is that of a three-story concrete-framed building from the water side. Shops and offices will, in fact, be established in the structure as a part of the repair facilities.

As shown in Fig. 3, the wind surface consists of an ogee slab interrupted every 65 ft. by a 25 ft. wide opening or vent extending from the ground to the third-floor level, to eliminate the possibility of troublesome suction currents on the lee side. Some 65 ft. deep from front to back, the structure is founded on spread footings tied together beneath the floor by concrete beams in both directions. Both by its unusual appearance and its height, the windbreak dominates the postwar skyline of the port.

Although what has been accomplished at Le Havre seems substantial, it needs to be contrasted with the fact that the major part of the deep-draft quais and the 6,600 ft. of quais fronting on the floating or constant-level basins remain unused; also that warehouses for covered storage as well as the crane equipment are insufficient; and that most of the movable bridges are of only temporary type. The port is still far from normal.

Long-time improvement program

Paralleling this effort of reconstruction has been the establishment of a long-time plan of improvement toward which the current work can be directed. Before the war, extension of the port to the east had been envisioned, but this idea has been abandoned in favor of remodeling the existing layout. Operations will be focused on three areas (Fig. 2): (1) Bassin de Mareé, where the deep-draft quais for ocean liners and other large boats are concentrated; (2) the "floating" or constant-level basins entered through the Quinette de Rochemont lock chamber and the Gate de Transatlantique; and (3) the Garage de Granville and the Canal de Tancarville in the eastern part of the port.

Enlargement of the "garage" to provide a large turning basin lined with new quais will supplement other quais along the canal which will be reserved for large, slow freighters that will reach the facilities through the Seine River estuary. In contrast, the western part of the port, where large ships have more rapid access, will handle passengers, miscellaneous merchandise and petroleum, the latter to be pumped through pipelines to storage along the Canal de Tancarville.

The layout of the deep-draft quais along the Bassin de Mareé is destined to undergo important modifications. Because both the Quai de la Floride and the Mole Oblique (Fig. 2), which were built in concrete on piles, were totally destroyed by German demolitions, they will not be rebuilt. Instead of being cleared, the debris—which includes several sunken ships—will be buried in a new fill providing what amounts to an extension of the Quai Joannes-Couvert of nearly 3,000 ft. In the reconstruction, the Mole Oblique will disappear (the end of it being dredged away), and a single long quai will result, backed up by storage areas and warehouses. In the process, a large new storage area will be provided in the triangular space between the Quai de la Floride and the Quai d'Escale.

The new layout will not provide quite as much docking space as previously, but the new Quai de la Floride and the Quai d'Escale will berth six or seven ships, and will also be available to large transatlantic boats if the 3,750 ft. Quai Joannes-Couvert is not sufficient for handling passengers. Of three maritime terminals that the port possessed before the war, two will be reconstructed, one on the Quai Joannes-Couvert, and the

FIG. 5. CHERBOURG as it appeared during the war when the U. S. Army Engineers were just beginning the construction of timber wharfs along the Quai de France (center) and the Quai de Normandie (right), which form the section of the port known as the Darse Transatlantique.

other on the new Quai de la Floride.

The only inconvenience of the new layout is that it deprives the Bassin de Mareé of the berthing posts along the north side of the Mole Oblique where they were protected from the prevailing winds, which blow from the southwest. The movement of large ships is sometimes difficult along the Quai Joannes-Couvert because of these winds. In any event, the port will still have available some 1,500 ft. of berths protected from the wind along the Quai d'Escale.

All of this new work is now the object of studies both as to the type of construction and to disposition of facilities. Another study involves the currents and wave wash that may be created by filling in the area between the Mole Oblique and the Quai de la Floride. A model has been constructed to a 1:150 scale to determine what currents will result, and to correct them if they prove disadvantageous. The model will also permit the study of other aspects of the port reconstruction and development.

Enlarged floating basin planned

The wrecking by German demolitions of all of the quais of the Bassin Bellot and the Bassin de l'Eure also provides the opportunity for considerable reconstruction and rearrangement in these two areas. One of the most important changes contemplated by the new plan is the complete removal of the divisions in the Bassin Bellot, making it in reality a part of the Bassin de l'Eure. (See Fig. 2) By this move there will be avoided the reconstruction of one gate, of two movable bridges and of more than 1,600 ft. of wrecked quais. Also in the Bassin Bellot it will give two continuous quais of 3,600 ft. each.

The total result of the rearrangement and the land removal shown in Fig. 2 will give the port a group of constant-level basins offering 12,500 ft. of 33-ft.-draft quais and 3,600 ft. of quais of medium depth. The creation of the large area of water in the Bassin Bellot offers, against its many nautical advantages, the disadvantage of eliminating the highway connections across it to the south side of the port. These connections have not been in service since the war and, as a result, highway traffic must take a very circuitous route. The new plan, therefore, involves an extension of Rue Marceau, the principal street of access to the port. This will cross the Bassin Vetillant east of Bellot on a fixed bridge having a shipping clearance of 26 ft., which is sufficient to clear the river boats coming up from the Canal de Tancarville to the port.

The equipping of the vast new mole bordered on the south by the deep-water quais of the Bassin Mareé and on the north by the new quais of the Bassin Bellot and of the Bassin de l'Eure is the object of careful study. The mole, of over 6,500 ft. in length, is the heart of the port, and its width of nearly 1,000 ft. should permit arranging its facilities in a satisfactory manner. These will include, in addition to the two lines of pier sheds, extensive railway and highway networks and the two marine terminals.

The Port of Cherbourg

A visitor to the harbor front at Cherbourg, familiar with its appearance after the U. S. Army Engineers had rebuilt and added to its war-demolished facilities in 1944, would at first note no great change. Most of the wharves are still in existence, and many are in daily use. Yet a more careful examination would reveal a substantial amount of work that has been accomplished by the French since the port was turned back to them October 15, 1945.

Except for four scuttled ships, none in channels of any importance, all sunken objects have been removed from the harbor. All lighthouses and signalling devices have been rebuilt, and work is continuing on removal of the enormous amount of debris—more than 25,000 cu. yd. of concrete mixed with pieces of steel framing

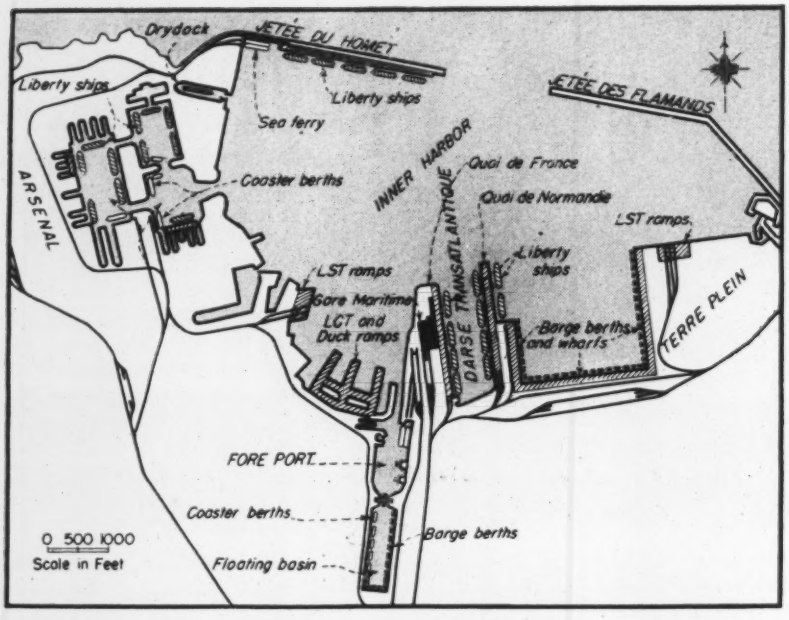


FIG. 6. THE HARBOR OF CHERBOURG, developed into a great freight port by U. S. Army Engineers, is still operating with these war-built facilities (shown hatched). First permanent reconstruction is centered on the Quai de France, the great prewar transatlantic terminal.

and all covered with deposits of sand that was dropped alongside of the deep-water quais by demolition charges. A great deal of repair to roads and considerable removal of debris of destroyed buildings has also been accomplished. And, in meeting the most urgent problem, that of constructing covered storage for merchandise, four new warehouses of temporary to semi-permanent type have been erected.

The port of Cherbourg before the war consisted (Fig. 6) of three sets of facilities—a group of gate-protected basins adjacent to the Arsenal on the west; a fore-port and a single basin on the south; and a deep-water dock, the Darse Transatlantique, formed by two moles known as the Quai de Normandie and the Quai de France. On the latter a large railroad station, the Gare Maritime, of reinforced concrete with arched roof, served the prewar transatlantic passengers. Cherbourg was then the principal passenger port of France, and played only a minor role in freight handling.

Reconstruction by U. S.

The story of Cherbourg's destruction and subsequent redevelopment by the American forces immediately after the capture of the port was told in *Engineering News-Record* May 31, 1945, vol. p. 758. What was done (indicated by the hatched areas in Fig. 6) represents one of the most remarkable examples of Army Engineer construction in the war. The work required four months, after which twenty-five times the quantity of merchandise that had been handled in peacetime was continuously passed through the port.

The prewar freight figure was 700 tons per day. By November, 1944 this had been swelled to 20,000 tons as a result of the building of 2,400 ft. of 22-ft. wide timber wharves along the Jettee du Homet and of 4,500 ft. of similar wharves in the Darse Transatlantique along the Quai de France and the Quai de Normandie for the berthing of Liberty Ships; by the lining of the perimeter of the dock area east of the Quai de Normandie with timber wharves, providing berths for 40 barges; by the construction of ramps for the discharge of LST's and Ducks; and by providing wharves on Seabee pontoons in the basins of the Arsenal and south of the fore-port basin.

During 15 months after the Americans took over, the port handled 3,004,819 tons, to which should be added 1,483,703 tons of petroleum products. In addition 130,219 troops had been debarked and 148,573 wounded and 124,206 prisoners loaded. Finally, most of the rolling stock sent to Europe was landed at Cherbourg, consisting of nearly 1,500 locomotives, 1,200 tenders and 23,000 freight cars.

Cherbourg's long-time reconstruction plan is tending in the direction of rebuilding the deep-water quais for transatlantic passenger service and of repairing the damage to the other prewar installations. In the future it is expected that Cherbourg will maintain its importance acquired during the war as a freight port without abandoning its first rank as a transatlantic passenger terminal.

The first work in connection with the reconstruction of the quais, which is just getting under way, is the re-

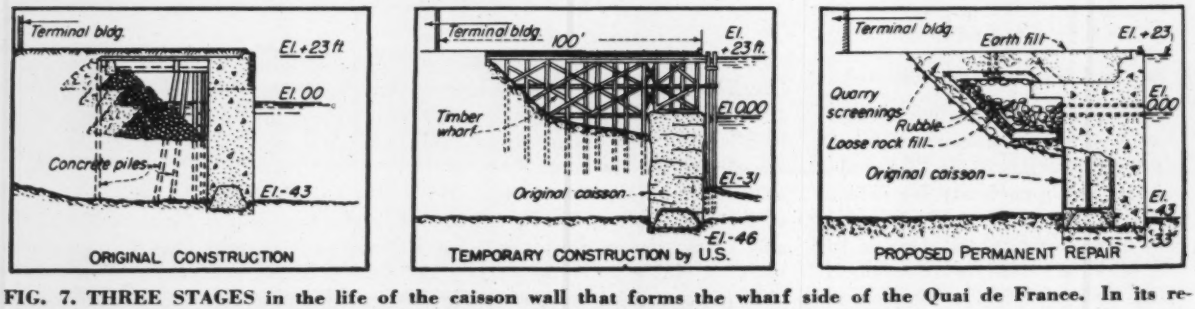


FIG. 7. THREE STAGES in the life of the caisson wall that forms the wharf side of the Quai de France. In its reconstruction (right) the wall will be increased in section, and new fill placed behind it.

building of the outer 1,000 ft. of the Quai de France. Both this quai and the Quai de Normandie are 2,000-ft. long and of similar construction—sand fills between mounds of large stones, with concrete caissons, each 100-ft. long by 20-ft. wide and 70-ft. high, forming a continuous vertical wall along the water side. While the Quai de France had been completed prior to the war, only the inshore 1,000 ft. of the Quai de Normandie was finished, although the entire length of its caisson wall on the Darse side was in place. In their demolitions, the Germans concentrated on the caisson walls of these quais. This debris now must be removed.

FIG. 8. SHEET-PILE COFFERDAM built across the entrance to the Marseille drydock basin (at right, out of picture) as a preliminary to dewatering and reconstruction.

Once the area is reasonably cleared, the temporary timber wharves, built over the caissons by the American engineers, will be removed, and repair of the usable and remaining parts of the caissons undertaken. The plan, as shown in Fig. 7, will be to increase the quai walls to a section large enough to resist the pressure of a new fill. This fill will be of a free-draining type made of loose rocks, rubble and quarry screenings, and in addition holes will be installed in the wall to equalize the seawater and ground water pressures. Rebuilding of the nearly 4,000 ft. of quais along the Darse Transatlantique is estimated to require four years, and the use of 60,000 tons of cement and 5,000 tons of steel.

Supplementing the reconstruction of the quais, and coincident with it as far as possible, the Gare Maritime will be reconstructed. First operations here will be to rebuild the northern part of the station on the outer end of the quai, which was not completely destroyed. Later, the south end will be rebuilt, utilizing as much as possible of the old construction.

Smaller items of planned reconstruction involve the driving of a new sheetpile wall and the placing of a fill along the east quai of the foreport; and the reconstruction of the swing bridge over the gate of the adjacent floating basin.

Entirely destroyed by the German army, the mechanical equipment of the port is also to be replaced com-

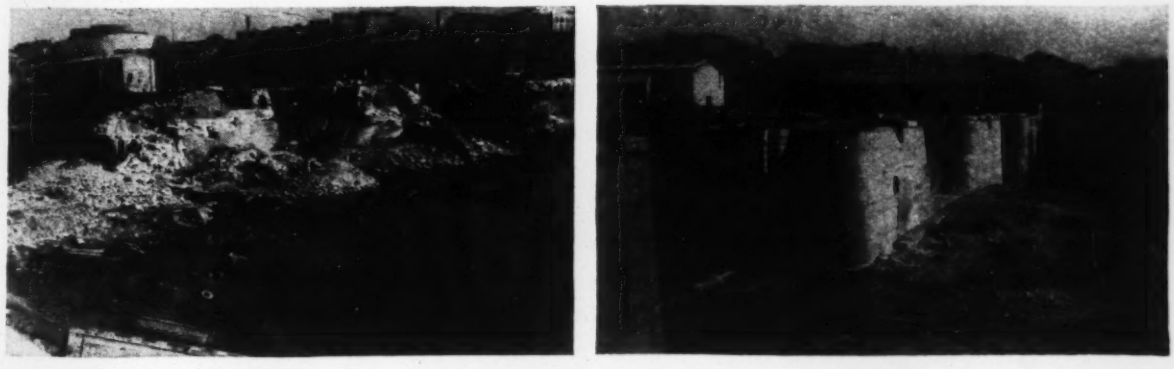


FIG. 9. DRYDOCK RECONSTRUCTION constituted the first postwar job in Marseille harbor. These before-and-after views of three of the six docks emphasize the magnitude of the task. Note the welded plate reinforcement that converted the dewatering pipe into construction bridges.

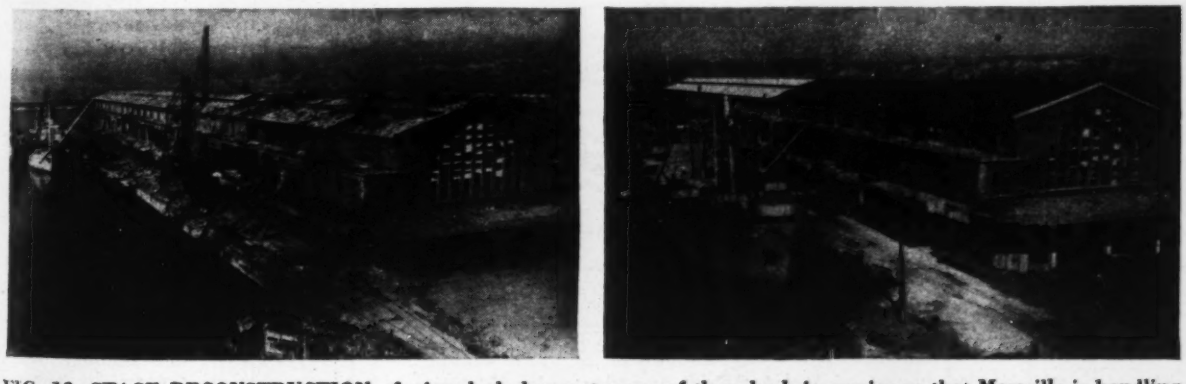


FIG. 10. STAGE RECONSTRUCTION of pier sheds has put many of them back in service so that Marseille is handling about 70 percent of its prewar tonnage. This shed is in the President Wilson Basin.

pletely. The first step has been taken by the acquisition of surplus American army equipment, largely floating cranes, although barges, crawler cranes and a few portal cranes are also involved. A French firm has also furnished eight electric cranes of 6-ton capacity and 100-ft. span, which will be installed on the reconstructed portions of the Quai de France and Quai de Normandie.

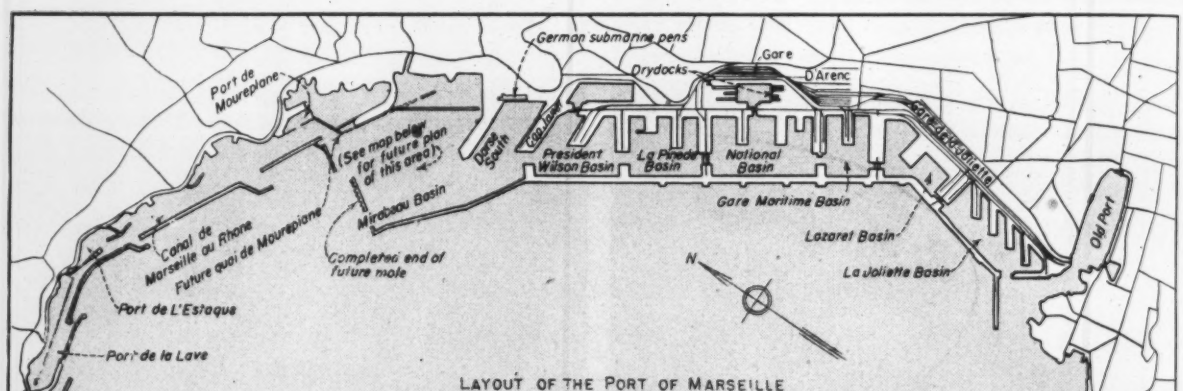
Thanks to all of facilities built by the American army, the port of Cherbourg can still handle a considerable amount of transatlantic shipping even though some of the temporary structures will have to be removed during the rebuilding operations. In 1946, the port handled 1,290,000 tons of merchandise and 24,000 passengers, and something over these amounts of traffic in 1947.

The Port of Marseille

Turning from the English Channel ports of Le Havre and Cherbourg to the Mediterranean port of Marseille, two points of contrast are evident. Although as badly damaged from German demolitions, Marseille did not have to contend with the repair of gates to constant-level basins (which are unnecessary with the relatively small Mediterranean tides), and it did not benefit from as much reconstruction by American military engineers that is useful to the postwar operation of the port.

One of these conditions is an advantage, the other a disadvantage, with the latter, unfortunately, outweighing the former. As a result, or so it seemed last summer, greater efforts at reconstruction are required and are being made at Marseille than at the other ports. And at the same time, current work at Marseille is more directly focused on the long-time improvement of facilities than is apparent currently at either Cherbourg or Le Havre.

The port of Marseille (Fig. 11) consists essentially of a series of finger piers with docking basins between, built behind the protection of a 3½-mile long seawall. Oriented in a northwest-southeast direction, the facilities begin on the south near the entrance to the landlocked "old port" (where the city's maritime history was begun in about 600 B.C. by the Phoenicians), and extend around the shoreline of the Gulf of Lion, virtually in the open Mediterranean. At the north end of the layout, dikes paralleling the shore form a protected "canal" through which medium-size craft can reach the great 50-ft. dia. Rove ship tunnel that provides connection with the Rhone River on the other side of the high hills that surround the city in a semicircle. An industrial district and extensive railroad yards occupy the area adjacent to the docking basins.



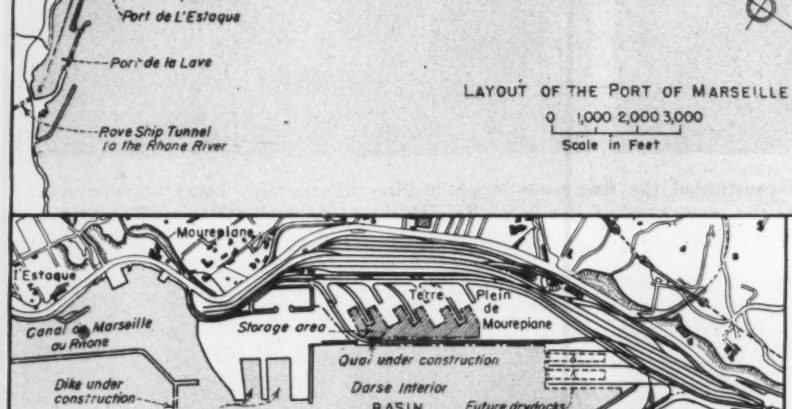


FIG. 11. MARSEILLE HARBOR as it is today is shown in the upper drawing. Below is a more detailed map of the new northwest extension as it will appear a dozen years hence after the current improvement plan is completed.

Marseille is the first port of France from a tonnage-handled standpoint, and this layout, extensive as it is, was being expanded before the war. The work on this long range improvement plan has now been picked up again, at the same time that the war-damaged facilities are being repaired to meet immediate needs.

How extensive this damage was may be appreciated by a brief review of what German demolition crews ac-

complished. Of the quais, which total 16 miles, nearly 14 miles were blown up by charges set every 75 ft., and only 11 of the 305 cargo-handling cranes remained in usable condition. Of the 376,000 sq. yd. of covered surface, 166,000 sq. yd. of buildings were entirely destroyed, and none of the remaining structures escaped damage. In addition, the group of seven drydocks and their common entrance basin was damaged beyond any hope of repair. Finally, the Germans sunk 173 boats and floating cranes throughout the harbor and within the various basins, perforating the hulls so badly as greatly to hinder salvaging operations.

Fortunately, the great seawall that protects (and creates) the port of Marseille was undamaged, and could be used by the American forces for some supply operations. Also, the quais of the old port some distance away were undamaged and could be utilized. Nevertheless, the U. S. Army Engineers instituted large-scale reconstruction operations on some of the damaged facilities in order to provide more berthing spaces. Many breaches in the quais were repaired in most cases merely by driving steel sheet-piling parallel to the quai and placing new fill behind. Not only was wartime docking space thus provided, but these temporary quais can be used for ten or fifteen years yet, although their type of construction will hinder their eventual permanent repair or replacement.

The other principal operation of the U. S. Engineers was to clear the entrances to the port and its quais, by breaking up many of the sunken ships with explosives, and pulling the wreckage out of the way. While this solved the problem of the moment, it is now complicating the repair of the port.

The French postwar salvage operations have been much slower than were the military ones, inasmuch as the French have properly wanted to save the sunken ships for future use. Refloating (Fig. 1) has been done by pumping, by displacing the water in the ships with compressed air after holes had been plugged up and by lifting with heavy cranes. In some cases it has not been necessary to refloat the ship completely, but only to raise it enough to permit its being hauled into a drydock for repair.

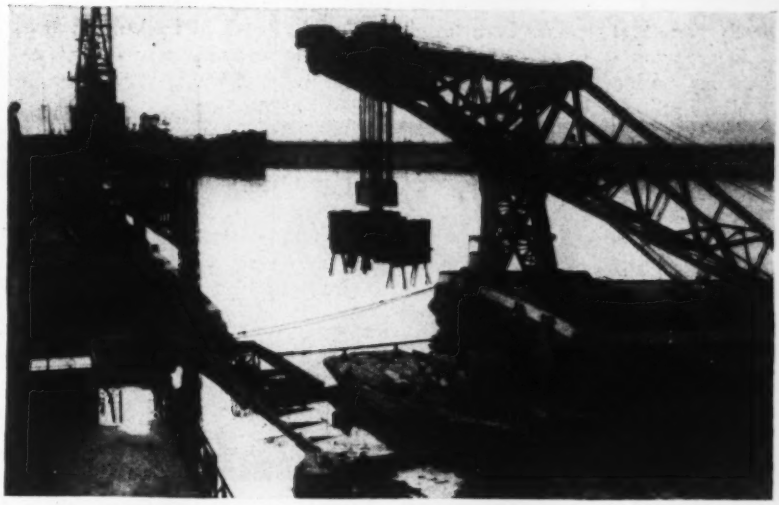


FIG. 12. REBUILDING a blown-out quai wall of cellular concrete caissons. By removing some of the filling, the caissons were refloated and moved back to position. The floating crane is of 450-ton capacity.

FIG. 13. THE NEW Terre-Plein de Mourepiane will be created in this section of Marseille harbor by a fill bordering the proposed Darse Interior. The huge Mole Leon Gourret, 3,300 x 900 ft., will be built about where the ships are anchored.

The presence of a 450-ton floating crane of prewar French design, which was not damaged by the Germans, has aided greatly in this work. In the end, it is estimated that it will be possible to recover 139,655 tons of a total of 178,265 tons sunk. At present, about 50,000 tons are in course of being refloated, and some 6,000 tons remain to be worked on.

Drydocks completely rebuilt

Because it was necessary to repair the raised ships in drydock, the initial reconstruction undertaken was to rebuild the destroyed docks. Since all seven of the drydocks opened into a common basin (Fig. 11), it was possible, by building a cofferdam across the entrance, to dewater the entire layout. This cofferdam, 92 ft. long and 35 ft. high, was formed by two parallel rows of steel sheetpiling 130 ft. apart, with the space between filled with fine sand. A pumping station, feeding two 36-in. diameter steel pipelines discharging outside the cofferdam, then dried up the area, revealing a great mass of wreckage, which was cleared out by crawler cranes loading into industrial railway cars and trucks.

During the following year the drydocks were rebuilt with 50,000 cu. yd. of concrete, a difficult task because cement was in short supply. Water

FIG. 14. THE GREAT SEAWALL that forms the present port of Marseille. Built of 450-ton blocks below water level (the rip-rap blocks shown are of 50-ton-size by comparison), the wall is being extended 2,000 ft. under the revised plans.

was let back in on August 29, 1946, and ship repair began soon thereafter. Currently, work goes on in reconstructing the walls of the quais, in removing debris, in repairing railway lines, and in reconstructing buildings on the various quais and moles.

Wall repairs differ

The repair of the quais does not represent the final construction, but they are planned to serve for 20 to 25 years, if necessary. One type of wall requiring repair is made up of precast reinforced concrete cellular boxes that were floated into place and sunk by filling with lime-concrete. Cement-concrete slabs sealed the tops of the filled boxes. The parts of these walls not immediately in front of the points where demolition charges exploded were in general only pushed out into the water and could be refloated and replaced after some of the filling had been removed. Other boxes, however, were completely broken up by the demolition, and have been removed in pieces by dredging. New sections of wall are then built in their place on the remaining debris.

Another type of wall, however, made up of solid precast concrete blocks, 14x7x7 ft. and weighing 30 tons each, has resisted replacement, and in most cases it has been necessary to construct a new wall in front of the debris of the old one. A new footing is usually placed on this debris with the aid of drivers, after which new prefabricated blocks are placed without difficulty. Some of the stone masonry walls, which have been similarly damaged, are merely being rebuilt in their wrecked alignment without any attempt at foundation or other underwater repair.

Vast extension underway

Coincident with their repair of existing facilities, engineers of the port of Marseille are directing their attention and whatever effort can be spared to developing and enlarging the port toward the north and west, in accordance with a plan adopted before the war. Basically, this involves extending the present seawall about 2,000 ft. and building a spur wall or dike out from the shores to enclose an area of about 500 acres.

Within this area, to be known as the Basin Mirabeau, a whole series of new modern facilities will be created, central of which is a great mole (the Mole Leon Gourret, Fig. 11) 3,300 ft. long and 900 ft. wide bounded by deep-water quais and equipped with warehouses, open storage areas and an extensive railway and road layout. Construction of the mole will divide the basin into three water areas: (1) a fore-port; (2) a protected dock, the Darse Interior, to the north; and (3) the Darse West, between the mole and the seawall, opening into the existing port piers and docks.

As shown in Fig. 11, the other new facilities will be established along the shore line of the Darse Interior. These include two petroleum basins, with 825 x 300-ft. quais, to be built on a new fill at the mouth of the Canal de Marseille du Rhone; a great terre-plein and Quai de Mourepiane on more new fill, where will be established storage facilities and a railroad freight yard, capable of handling 1,500 cars daily; and two new drydocks about 1,000-ft. long and 140-ft. wide, capable of servicing the largest ships which is not possible in the existing drydocks whose maximum length is only 675 ft.

Despite the logic and necessity of extending the port toward the north and west, three disadvantages must either be accepted or overcome. These are (1) the shore is narrow because of the encroaching hills, which limits the area for industrial development; (2) the water is very deep, which complicates construction; and (3) the new basin is exposed to the Mistral (the name given a sudden, violent and periodic northerly wind), and this can complicate ship operations unless carefully-devised protection is provided.

Protection from the wind

Of the three difficulties, the Mistral offers the greatest threat, since wind-generated waves striking the north quai of the Mole Cap Janet now create choppy water in the existing south part of the port. Also, despite proposed seawall protection on the south and west, waves from these directions can come in through the entrance and strike the proposed Mole Leon Gourret. Accordingly, in the design of the mole, provisions have been made to meet these two possibilities.

In the first place, the mole is ori-

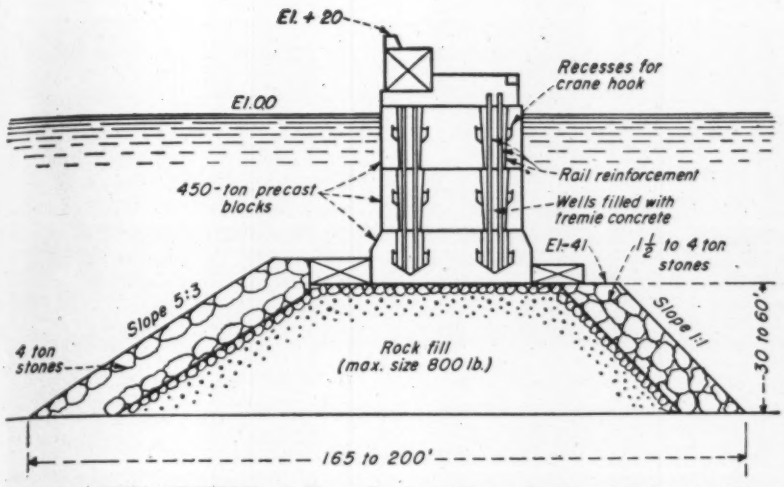


FIG. 15. THIS SECTION of Marseille Seawall emphasizes the large dimensions necessary to establish it safely in water as much as 100-ft. deep.

FIG. 16. BEHIND the Marseille seawall, workmen demolish one of the German pill-boxes whose guns dominated the sea approach to the port.

ented parallel to the Mistral so that anchored ships will have a minimum of exposure to the wind. In addition, as will be noted in Fig. 11, the end wall of the mole has been extended beyond the mole itself, to narrow the water entrance to the south part of the port, and thus give it some protection. This end wall, already completed, is a great bulwark of cyclopean blocks stacked four high and resting on a deep and wide rock-dumped fill whose purpose is to weaken the reflection of the waves back into the fore-port. Its design is similar to that of the seawall described below.

To build all of the above facilities at once is obviously impossible. Accordingly, after construction of a new north quai along Cap Janet and another on the opposite side of the Darse South (to be a part of the future Mole Leon Gourret), the following order of priority has been established: (1) prolong the main seawall 2,000 ft.; (2) construct a 1,500 ft. dike along the north side of the proposed fore port to protect it from the Mistral; (3) build the 2,500 ft. Quai de Mourepiane; (4) construct the main part of the central Mole Leon Gourret; and (5) construct a 900 ft. dike and quai across the north end of the Darse Interior. Work has begun on the north dike of the fore port, on the main seawall extension and on the Quai de Mourepiane.

Because it is founded in water in some places up to 100 ft. deep, the sea-wall (and also the end wall of the Mole Leon Gourret referred to above), is a spectacular structure. Consisting of 450-ton precast blocks piled three high on a huge dumped-rock base, it is surmounted by a superstructure wall of smaller blocks that extends 20 ft. above the water level. Precedent for the design exists in the last 800 ft. of the seawall, which was built just prior to the war to extend the original wall, a dumped-rock fill wide enough to be used as a quai, (and which was used extensively for this purpose by the American Army during the war).

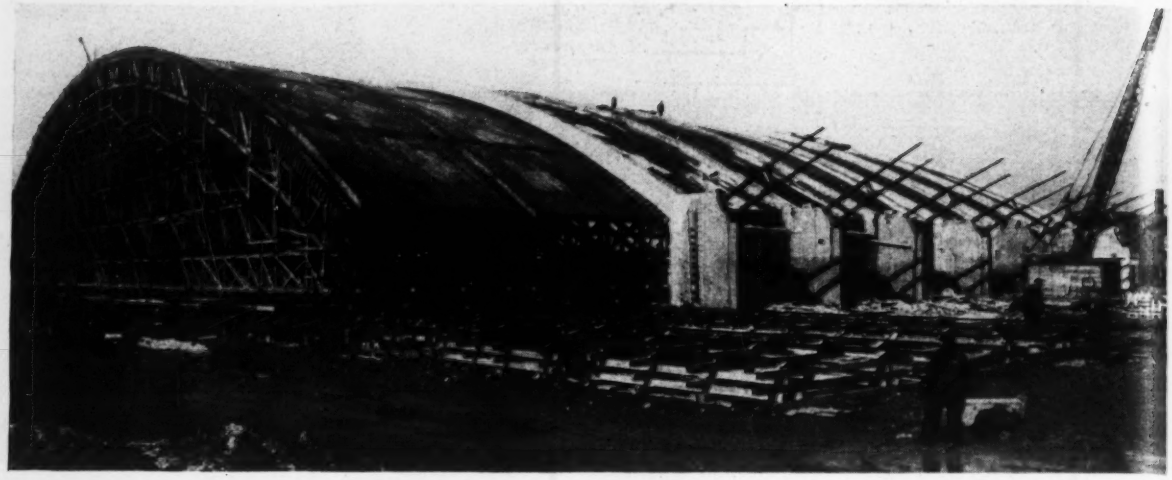
As shown in Fig. 15, the rock-fill base of the new wall will be from 165 to 200 ft. wide and from 30 to 60 ft. high depending upon the depth of the water. A total 1,358,000 tons of rock is required and, at an estimated rate of placing of 35,000 tons a month, the work will require something over three years.

The rock fill will be leveled off at El. —41 ft., and, after allowing a year for settlement, the wall of 450-ton precast concrete blocks will be placed. The bottom block will be about 50x15x10 ft., while the two upper ones in each pile will have dimensions of about 35x15x10 ft. Each block is pierced vertically with two holes or wells, which considerably reduce the handling weight of the blocks, but whose real purpose is, first, to provide a means of picking up the blocks, and then to furnish a key through which the three blocks in a pile are tied together. Recesses inside the holes give support for the special hooks of the floating crane. After the blocks are in place, vertical reinforcing of railroad rails is inserted, and the holes filled with concrete. Then the superstructure wall is built on the blocks, and a 4-ton stone riprap laid on the sea side of the wall as shown in the photo of Fig. 14.

For the wall that will constitute the Quai de Mourepiane, the south part will follow a design, in 450-ton blocks, similar to that used for the seawall. For the north part, however, precast cellular concrete caissons will be used. Of 43x43x26 ft. in size, they are being cast in a temporary dry-dock in the President Wilson Basin, floated to position and sunk by filling the fifteen cells. All outside cells, except those on the land side, are filled with concrete; the remaining cells are filled with sand and simply covered with a concrete slab. Joints between the caissons are plugged front and rear with sacks of concrete placed by divers and then filled with concrete. These caissons, like the concrete blocks, are founded on a bed of dumped rock leveled off at El. -41 ft.

The fill behind the quai wall, forming the Terre-Plein de Mourepiane, will be in part dry material from the demolition work and in part hydraulically-placed material. Most of the actual terre-plein acreage will be hydraulic fill.

With the completion of all these facilities a dozen years hence, Marseille will have a much enlarged and modern harbor that its designers feel sure will remain the first port of France and of the Mediterranean.



TIMBER TRAVELER for 275-ft. thin shell concrete hangar arch is moved into the open to be shifted to the vacant space at right for forming the second span of new structure at Chicago airport.

Form on Traveler Speeds Arch Concreting

Nomer Gray
Development Engineer, Walter Kidde Constructors, Inc.
(Formerly Resident Engineer, Ammann and Whitney, Consulting Engineers)
New York, N. Y.

UNUSUAL FORMING, concreting and stripping operations characterized the construction of the thin-shelled arch roofs of two 257-ft. span hangars built at Chicago airport for American Airlines. The structures are each 175 ft. deep along the longitudinal axis and both have a conventional three-story reinforced concrete office and shop building at the end opposite the field. (*ENR* July 22, p. 55)

Higher strengths and thinner sections were used than has been common in American practice, thus placing far greater responsibility than usual on contractors and field engineers to assure concrete consistent with design assumptions.

Spread footings on silty-clay soil at a depth of about 8 ft. below general excavation provided adequate support for the structure. General site excavation was done with carrying scrapers. The soil stood up well, permitting footing and similar excavation with clamshell or backhoe with very little hand trimming, even in corners. Footings and buttresses were poured to the springing line before work started on the arch roof.

The hangar roof was built during the winter of 1946–1947, using high-early strength cement. Forming the arch shell was the interesting job from a construction viewpoint, since the Whitney design used puts the 3½-in. thick shell on the neutral axis of ribs spaced 29 ft. c. to c. The ribs vary in depth and extend a maximum of 29 in. above and 16 in. below the barrel. Thus, provision had to be made for lowering the forms about 2 ft. vertically as well as for supporting rib forms above the barrel, to permit re-use of the forms.

Average height of the roof is about 40 ft. above the ground with the high point at 62 ft. Design permitted construction joints at 58 ft. centers to be spaced in the center of alternate arch ribs, so that each hangar could be constructed in three monolithic pours.

Frame on rails carries ten trusses

The form problem was solved by the use of a traveling timber framework about 60 by 250 ft. in plan, mounted on ten rails that ran transverse to the arch span, (Fig. 1). This framework was surmounted by ten trusses that lay parallel to the span. The trusses were separated into nine sections along the span, with the top chords cut to the arch curve, and carrying purlins stiffened by bridging. Plywood nailed to the purlins served as the form surface.

The trusses were supported on screw jacks, permitting accurate vertical adjustment of the sections to the cambered arch curve and decentering. Since ordinary screw jacks could not safely run the approximately 2 ft. necessary in de-centering to clear the ribs, a supplementary set of jacks was used.

The jacking operation was as follows:

When first erected and during each traveler move, no jacks were in place. The butt ends of the vertical struts supporting the trusses were in bearing. To raise a section of the traveler, long ratchet jacks were placed between lugs bolted to the struts above and below the joint. Working in unison, 20 men rapidly raised a single section—about 30 x 60 ft.—to within about 2 in. of final elevation. The smaller screw jacks were then inserted

in the line of the struts, and the ratchet jacks shifted to the next section.

Final close adjustment to the cambered position was made by use of the screw jacks. Filler pieces of plywood were then fitted across the joints to complete the surface. These operations were performed in reverse order for decentering.

The entire framework could be moved on the rails by applying a horizontal force of about 3 tons. A single line from the drum of a crawler crane was sufficient.

Concrete mixed on job

The 13,000 cu. yd. of concrete required for the hangars and lean-tos did not justify setting up a plant at the site. Since transit-mixed concrete is not available in Chicago, batched materials were purchased for charging pavers located near the forms. The mixed concrete was handled by buckets and cranes, and concrete buggies for distribution where necessary.

The aggregate used for all structural concrete was a crushed limestone locally available. Limestone has a lower thermal coefficient of expansion —an advantage in reducing the rib temperature stresses. The stone normally contained 3 to 5 percent of chert, and while undesirable for exposed concrete (due to surface "popping" attributed to chert) was acceptable since all structural concrete is permanently covered.

Specifications required 4,000 psi. concrete for the roof. To permit early stripping and re-use of the form, high early strength cement was used. After a study of the available aggregates and considering that the concreting would be done in winter weather, a water-cement ratio of 5.5 was used, requiring 6.5 bags of cement per cubic yard.

It was found that a slump averaging about 4 in. would stand without difficulty on a slope of 34 deg. on the roof. This was partly attributable to the restraining influence of the wire-mesh reinforcement but close control of the consistency was essential to prevent segregation or honeycomb in the thin-shell and the ribs.

Concrete was placed by two gangs working up from each springing line for the full 58 ft. width. A crane and mixer worked with each concrete gang and care was taken to keep the number of batches from each mixer about the same to avoid distortion of the form from unequal loading. Buggies were tipped at several points along the uphill edge of the run, dropping the concrete a distance of about 4 ft. to the form. The richness of the mix aided in preventing segregation, as is attested by almost complete lack of honeycomb. The entire area of shell and the ribs were very fully vibrated.

THE TRAVELER is raised about 2 ft. by hydraulic and ratchet jacks.

CONCRETE is hoisted by cranes and distributed over the form by buggies.

The surface was finished with a wood float, working downhill from each buggy run. The 3½ in. shell thickness was controlled accurately by using a metal probe with a small cross-piece welded 3½ in. from the end.

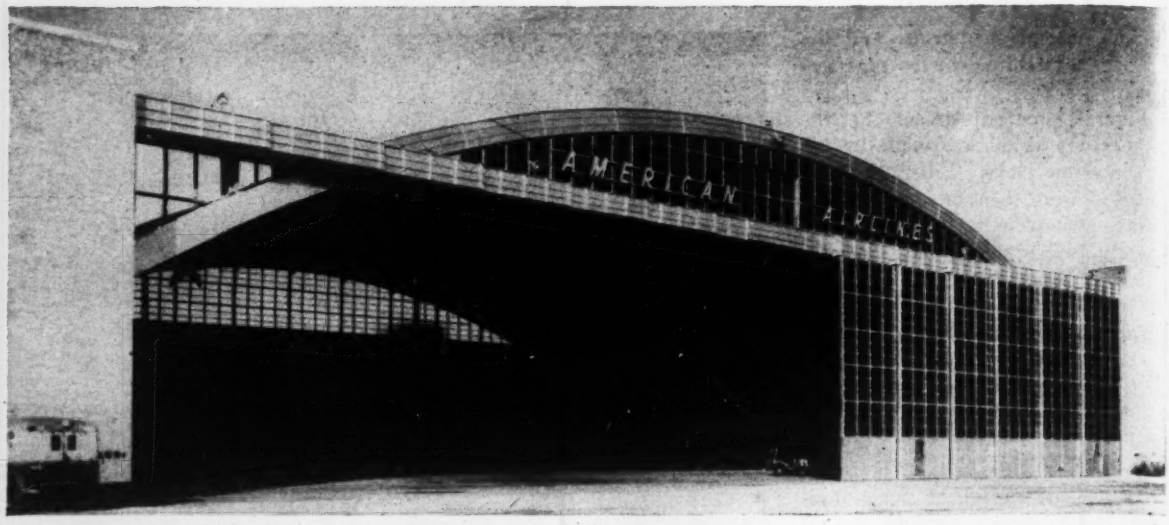
The roof of each hangar contains about 1,150 cu. yd. of concrete, of which 60 percent is in the shell and 40 percent in the ribs. Each hangar was constructed in three monolithic pours.

Danger of fire in the timber framework and the large surface area involved made it undesirable to attempt inclosure for heating. The course followed was to avoid pouring in extremely cold weather, using long-range forecasts obtained from American Airline's meteorologists.

It was to be expected that bad weather would be encountered. While placing concrete in one section the temperature hovered around 32 deg. F. all day. Aggregates were heated at the batching plant, and mixing water was heated to about 100 deg. at the site so that concrete was deposited at an average temperature of 70 deg. After two hours the temperature was 55 deg. in the thin shell. As the concrete could be walked on within four hours, the entire surface was then covered with hay and tarpaulins. The following morning, with a night temperature of about 30 deg., the average temperature under tarpaulins was 44 deg.

As the ribs are the principal structural element supporting the roof and the strength gain is closely related to the internal concrete temperature during curing, a close temperature check was maintained through thermometers inserted in the ribs at several points, from which temperatures were read for several days. On the day after the pour, internal rib temperatures were observed from 20 to 35 deg. higher than the air temperatures. Concrete temperatures followed the air variations but gradually converged to air temperature at about the third day following the pour. Such temperatures assure a satisfactory rate of strength gain.

Specifications required a minimum strength of 2,500 psi. before de-cen-



FINISHED HANGAR IS capable of accommodating several commercial airliners in its 175 x 257 ft. of floor area. Lean-tos at rear provide space for office personnel.

tering. A minimum of twelve test cylinders were made for each pour to determine the earliest time for decentering. These were exposed to conditions similar to those of the rest of the concrete. The ratio of mass to exposed surface area is much less in the cylinder than in the ribs of the structure, which normally would result in lower curing temperatures in the cylinder and hence lower early strength. In spite of this, the cylinders invariably showed strengths higher than 2,500 psi. by late in the third day, and in all six pours the forms were lowered on the 4th day following the concrete placing.

Tests on cylinders at seven days usually showed strengths over 4,500 psi. Several cylinders tested after four months had strengths exceeding the 7,100-psi. capacity of the available testing machine.

Decentering done uniformly

To assure gradual and uniform application of its own load to the arch, successive sections of the arch form were lowered in several passes, from crown to springing line. In assuming its load, the arch immediately dropped a distance of about 1¼-in. at the crown.

The practice in lowering the form was to start two gangs slackening off the screw jacks at the crown section by exactly ½ in. The gangs moved evenly from section to section toward the springing line until the entire form had been dropped. A "draw" of 1½ in. in the width of the rib below the barrel aided in freeing the form. This operation was repeated four times until the traveler had dropped 2 in. and had broken free of the concrete. Then, using the long ratchet jacks, the form was dropped section by section the 2 ft. necessary to bring the struts into bearing and release the jacks.

The centering was dropped easily and rapidly. A common experience was to have the entire form dropped 2 ft. by 1:30 p.m. the day the decentering started and have the traveler moved to the next pouring position by 3:30 of the same day.

Without adverse weather, the normal cycle for concreting adjacent roof sections was two weeks—the entire roof of the first hangar was concreted between November 14 and December 22. The form was moved outside the structure and shifted on supplementary tracks to the line of the second hangar.

Floors for the hangars—with a total area of 100,000 sq. ft.—were designed for heavy plane loads. Bank-run gravel was compacted over the area for a depth of about 30 in., and a 10-in. concrete slab placed. The floor is unusual in that the only expansion joints provided are at the perimeter, where a 1 in. thickness of cork is placed between walls and floor. The floors have a one-inch integral topping course containing a select, hard ⅜-in. gravel aggregate and a cement content of 11 bags per cu. yd. Concrete was placed, by crane and bucket, in panels about 30 ft. square in checkerboard sequence. Power floats were used to secure maximum surface density with a final "flat" trowel finish applied by hand.

The three-story office building at the end of the hangars provides about 100,000 sq. ft. of floor space and required about 5,000 cu. yd. of concrete. Concreting followed the same general methods of handling.

Concrete observations

Although no exterior concrete is visible in the completed structure, the hangar roofs were exposed for several months to allow a close examination of the concrete through a severe winter and a hot summer. The flexibility of the ribs in this design eliminates the cracking that frequently arises from distortion in rigid masonry arches. Not a single crack was observed in the ribs or abutments during seven months exposure to the elements. The entire roof is now protected by one inch of fiber board insulation and a built-up roof so the future temperature and moisture variation will be much smaller.

Construction for American Airlines was supervised by W. E. Hendricksen, with Glen Markt in general charge as Director of Airports and Buildings. Corbetta Construction Co. were the general contractors, with Harold W. Murray as project manager.

The project was designed by Ammann and Whitney, consulting engineers, for whom the writer and James S. Whitney acted successively as resident engineers.

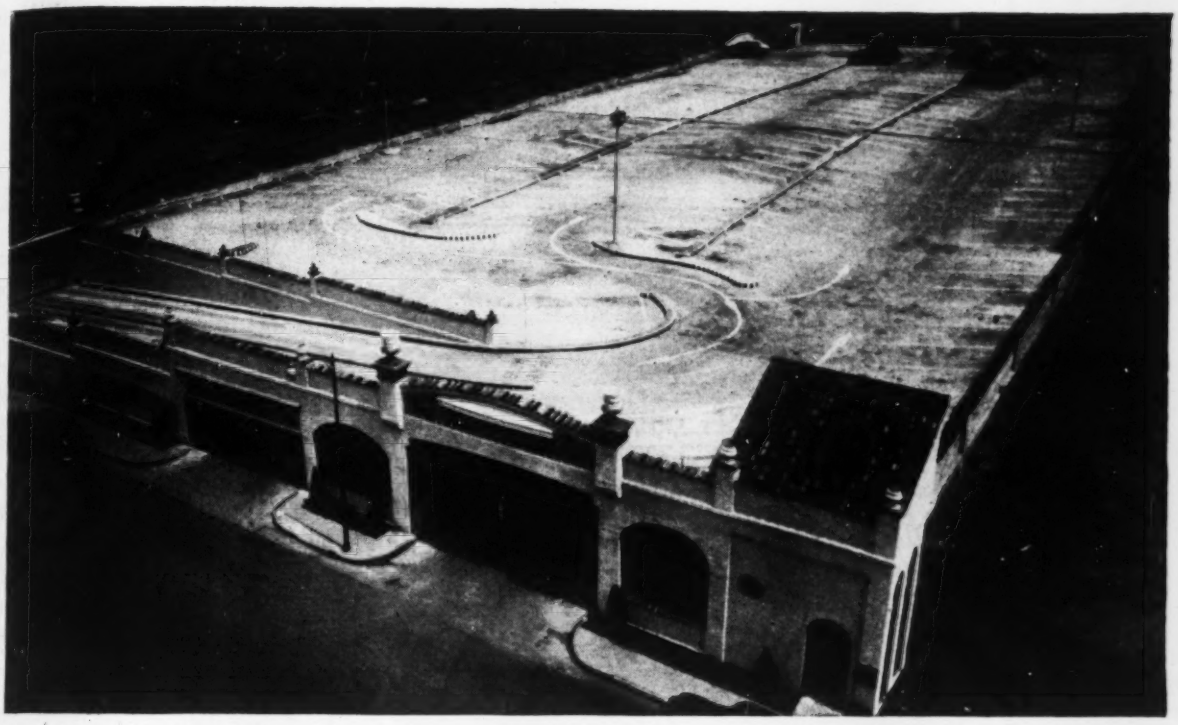


FIG. 1. TRIPLE-DECK PARKING STATION IN KANSAS CITY takes advantage of sloping ground for short ramps to each of three levels. Car operators park their own machines.

Long-Span Triple-Deck Parking Station

Davis K. Jackson

Business Property Department, J. C. Nichols Co., Kansas City, Mo.

LONG RIGID-FRAMES in a triple-deck parking station in Kansas City, Mo., permit angle parking on each side of three drives on three levels. Column interference is practically eliminated by the long spans so that drivers park their own cars in this privately-owned 571-car facility, where parking is free.

The new parking facility is in the "Country Club Plaza," an attractive and restricted business area developed over the past 20 years by the J. C. Nichols Co. Free parking facilities—in open lots—always have been maintained for use of tenants and patrons. Increased need has demanded expansion of the facilities.

Space ideally suited for a multiple-level station was available in an area 162 x 376 ft., with access from three sides. The street on one side of the plot is 9 to 13 ft. higher than on the other, and the street at the end slopes so that automobile entrances at different elevations are easily provided.

The parking space is planned with 13-ft. 6-in. headroom on a large part of the lower level so that delivery trucks can serve shops in the area. The second level has a minimum clearance of 7 ft. 6 in. The top is open, but a decorative barrier restricts clearance here to 7 ft. 6 in. The city building code permits 100 psf. loading for passenger cars, but requires 250 psf. for trucks. The limitation in headroom is expected to prevent truck movement to the higher levels.

All entrances to the station are of a width to permit two-way traffic.

A width of 18 ft. at right angles to the curb is allowed for parking, a 16-ft. width is allowed for one-way traffic, with 26 to 28 ft. for two-way roadways.

The first level is below street-grade, with minor slopes to facilitate drainage; entrance ramps slope 10 percent or less. Second and third level paving is "warped" so that access to the third level can be obtained without reduction of parking area on the first and second levels. The second level has a variation of 8 ft. between a low point in the northwest corner and a high area, which is uniform over the south bay. The third level has a variation of 5 ft. roughly parallel to the second level. The entrance ramp to the upper level is on an 11 percent slope.

One of the principal objections to many multi-story parking garages is that the structural layout is such that not only are columns present in the rear but also in front of the parking space, making it difficult to move cars in and out. Pedestrian travel to and from the automobile also is made difficult. Additionally, parking under cover has psychological disadvan-

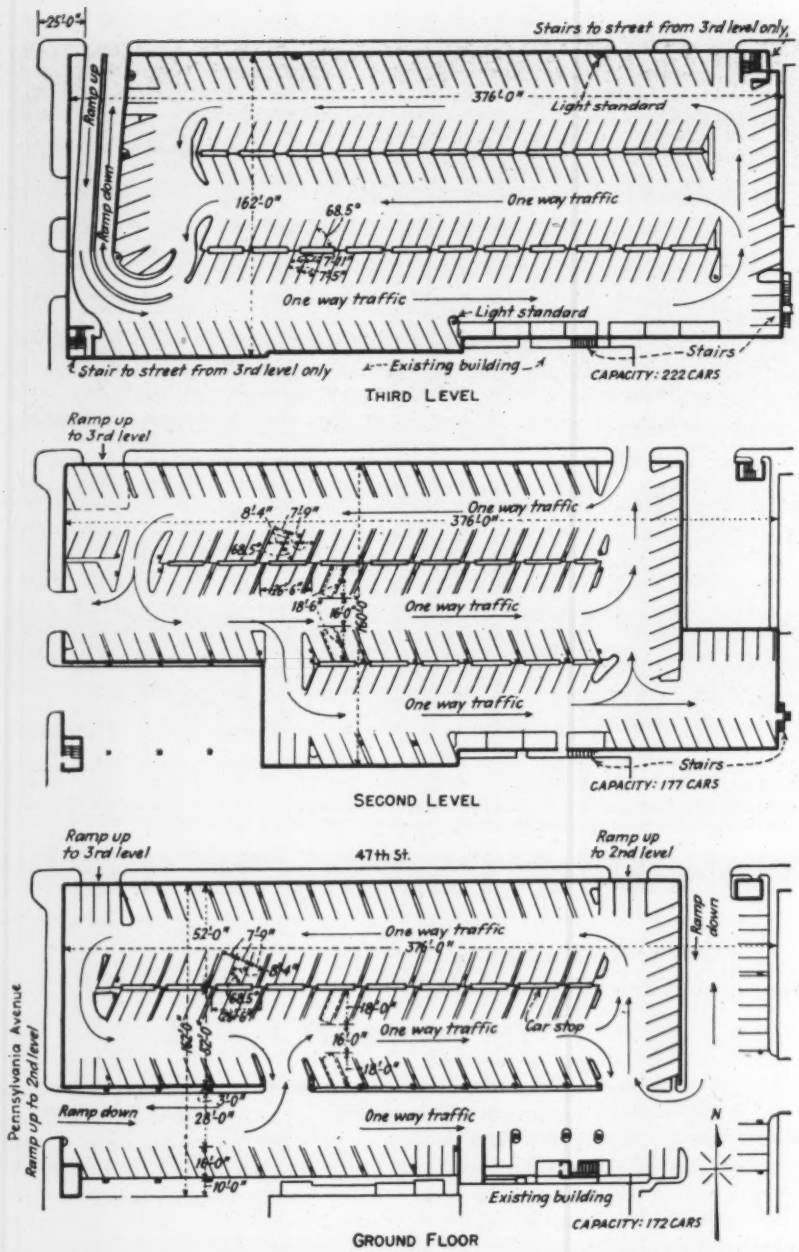


FIG. 2. TRIPLE-DECK STATION accommodates a total of 571 cars. Ramps and entrances are two-way; roads are one-way.

tages, according to information gathered from all over the country on multiple-deck parking facilities.

Although it was found that only in rare instances do car operators park their own cars in multi-story structures, that method was adopted for this structure although it is perhaps the largest structure of its kind in this country. When cars are parked by an attendant, it is possible to maintain much closer clearances and to move the cars to effect the greatest efficiency.

The Nichols Co. has had long experience in operation of open lots, and always has used right-angle parking, with an average of 65-ft. bay widths and 7 ft. 6 in. to 8 ft. for the width-of-car space.

The area available could not be readily arranged to accommodate a maximum number of cars with such a layout. But extensive studies showed that for the 162 ft. width a diagonal parking pattern, with cars on each side of two one-way traffic lanes on each level, would be satisfactory. To maintain headroom and yet hold to minimum overall floor heights, long clear spans of shallow depth were required.

A layout was developed so that cars are parked at an angle of 68.5 deg. to the line of traffic with car spaces 7 ft. 9 in. wide on the first and second levels and 7 ft. 5 in. on the open third level. This angle and spacing has been found satisfactory in other installations, though it has been observed that drivers angle-park at 50 to 55 deg. where they are not restricted. With good guide lines, cars are parked at the sharper angle, however, and more spaces are made available than by right-angle parking.

Columns spaced for ease of parking

By designing for continuity across the 162-ft. width, long spans with minimum depth beams could be utilized. A span of 50 to 54 ft. center to center of supports gives the desired width for parking, while two pairs of columns 4 to 8 ft. apart support the beams. The structure cantilevers a few feet over single outside columns. Beams are 16 in. wide and 3 ft. or less deep, with haunches not exceeding 4 ft. 6 in. Floor beams 6 to 8 in. wide and 20 in. deep on 3-ft. centers, made integral with a 3-in. thick, mesh-reinforced slab, span the 26.5 ft. between beams. Columns are 12 by 24 in. and are placed at the angle of the parking stripe to take up a minimum of space.

The 25.5-ft. net space between columns permits three 7-ft. 9-in. parking spaces at the 68.5-deg. angle. In addition to the width of car space provided, the columns between each group of three cars actually give additional space for pedestrian movement to and from the vehicles. There seems to be considerable psychological advantage in this arrangement.

Construction to a usable stage was done in late 1947, with final finish completed this spring. A design strength of 3,000 psi. was used for concrete, with compression tests indicating an actual strength of 3,500 to 4,200 psi. at 28 days. Air-entrained cement was used throughout. This type of cement provides protection against calcium chloride—which will probably be used for snow removal on the ramp to the third level—but as a safety factor it was thought advisable to increase the thickness of

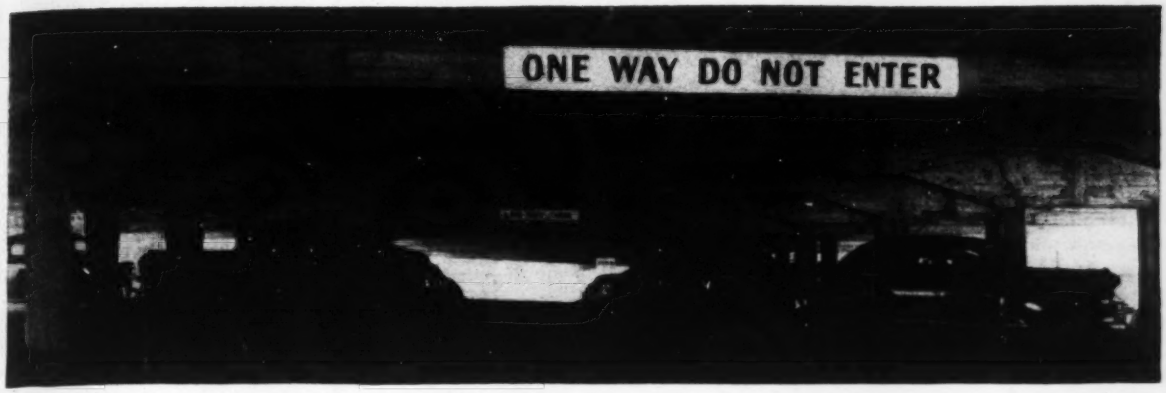


FIG. 5. DOUBLE COLUMNS, skewed to the 68.5 deg. angle of parking, support shallow continuous concrete beams.

the ramp to the third level an inch over the design requirements.

One transverse expansion joint is provided at about the middle of the structure. A row of columns is located on each side of this joint while angle and plate covers are used in the floor to permit 2-in. expansion. As passage of water through construction joints would be a considerable nuisance, a special detail was developed, using a tapered wood strip 1½ in. wide tacked to the top of the header and allowed to remain until the adjacent concrete was placed. The groove left in the concrete was caulked with oakum and mastic to maintain a water-tight joint.

The deck concrete serves as the parking surface for the second and third levels. Bituminous penetration macadam, laid directly on the ground, is used for the lower level.

Surface water is carried to two low points where it is collected by catch basins with special sumps to trap grit and dirt and then drops through vertical pipes to storm sewers below.

The first and second levels of the structure are equipped for day and night lighting, utilizing 200-watt lamps and reflectors at about 25-ft. spacing to give an even distribution and an intensity of about 5 to 6 foot-candles.

Because of apartments and offices on all sides, the third level required special care in placing the lights. After exhaustive studies, five towers 25 ft. high were built, each equipped with 20 adjustable floodlights. No complaints have been received from neighboring office or apartment tenants. Time-clocks control all of the lights.

A feature of this parking station, from the retail merchant's standpoint, is easy access by vehicles and pedestrians. The first level has the greatest movement of passenger vehicles and also accommodates a considerable volume of truck traffic, servicing the stores to the south and the east. Three entrances and exits are provided, each from a different street. Entrances are provided from two streets for the second level, and for the third floor, a single entrance is provided from the highest available street at a point of relatively low traffic density. Parking turnover on the third level is low and no congestion has been experienced.

Signs aid parkers

Effective wording and placement of directional and informational signs quickly taught users to place their cars properly in the parking stalls. Signs that do not receive enough illumination from the general space lighting have built-in trough lighting. This form is used principally in the exterior signs. Deflector or guide islands are used throughout for guidance of moving traffic. Medial or buffer strips are placed between lanes.

Raised walkways along the roadways handle necessary pedestrian travel. Stairs lead from the street to the third level, and direct connections to second-floor corridors of adjacent buildings are provided from the second and third levels of the parking station.

Cleaning the station is done by flushing the top and second levels with a hose. This method seems to be preferable to use of a lightweight street sweeper, but alternate means are under study. On the first level, a combination of hand sweeping, rotary construction broom, and a street sweeper is used, to work around the concrete guide buttons. Cleaning is done as required rather than on a schedule, and is supplemented by a weekly pick-up of trash.

To conform to the very high standards of architectural design maintained in the Country Club Plaza, considerable expenditure—perhaps ten to fifteen percent of the total cost—was made for the beautification and ornamentation of the structure. Careful attention to the design of exterior walls has resulted in rather straight lines that do not reveal the differences in elevation of the second and third level decks. Mexican tile are used on the top surface of all walls. The exterior surface of the structure has a dash-coat of cement stucco of a pinkish cast.

While experience in operation of this parking station is limited, it has been found that the limiting grades of 3 to 4 percent in each parking level are about the maximum that should be used. While the ramps have a 10 or 11 percent slope in several cases, it appears that more satisfactory results would be obtained if grades could be held to 8, or a maximum of 9, percent. However, nothing has developed that appears to be an important obstacle to the success of the facility.

The design and planning of the structure was under the supervision of E. W. Tanner, chief architect of the Nichols Co., with Harry Noble, consulting structural engineer, and C. R. Wood, consulting electrical engineer.

Construction was supervised by J. V. Walker, chief of the Nichols construction department. The writer is responsible for management and operation of all of the company's parking facilities.

READER COMMENT

Western Plumbing Code

Sir: The work being done on the Pacific Coast by the Western Plumbing Officials Association should be of interest in connection with the need for more uniformity in Plumbing codes. In *ENR* June 3, vol. p. 923, the activity of federal agencies on such a code is reported.

Many West Coast cities and counties have already officially adopted the Uniform Plumbing Code prepared and promulgated by the Western Plumbing Officials Conference. This code was prepared by city officials, engineers and plumbers to dispose of the unnecessary lack of uniformity in regulations between neighboring cities. The first code was adopted in 1945 and was revised in 1946 and 1947 as experience in actual application was accumulated.

The Uniform Plumbing Code was quickly adopted by some 100 cities and counties, including the City of Los Angeles and the County of Los Angeles. Uniformity in plumbing regulation is an accomplished fact in the West through the efforts of the Western Plumbing Officials Conference, whose code provides the general standards sought by the federal agencies.

This is encouraging to those of us who would like to see some local initiative instead of the popular tendency to cling to the hand of the federal government. The efforts of the HHFA to do something useful should not be discouraged, but, so far, the only practical and workable codes have been developed by organizations of building officials with experience in enforcing building regulations. The Western Plumbing Officials Association is to be commended for its work in developing a usable uniform plumbing code.

G. E. MORRIS
Superintendent of Building
City of Los Angeles, Calif.

More on Venturi Tubes

Editor's Note: Critical comments on the article, "A Simpler and Better Venturi Tube," by J. C. Stevens (*ENR*, April 29, vol. p. 659) are contained in the following letters from I. O. Miner, L. J. Hooper and W. S. Pardoe. Other discussions of the article may be found in the issues of June 10, vol. p. 973 and June 24, vol. p. 1040 and 1041.

Sir: Mr. Stevens does not state in his article why his Venturi tube should be used in place of an orifice meter, which, of course, would be much cheaper. Surely the reason cannot be greater accuracy because only a few Stevens meters have been calibrated as compared to thousands of orifices similarly tested. It does not seem that the Stevens meter should be used to obtain longer life because the last two paragraphs of the article mention cavitation difficulties with this type of Venturi tube.

The reason for using a Stevens meter apparently is to save pumping costs or obtain a constant coefficient down to a lower rate of flow. If money can be saved by using Stevens meters, still more money can be saved by using conventional Venturi tubes. The loss of head for a long conventional Venturi tube is 10.5 percent of the differential, and for a short conventional Venturi tube it is 14 percent of the differential for ratios of inlet to throat diameter similar to those of the "tested" Stevens tubes. These losses are respectively only 39 percent of the highest to 56 percent of the lowest of those given in Table II for the "simplified" Venturi tubes without valves in downstream cone.

The figures for tubes with valves in the downstream cone have been ignored because, obviously, the valves increased the losses. The losses indicated for the 12 x 8-in. cast-iron tube have also been ignored because this tube had a diverging cone with a much wider angle than the others and, hence, the losses should have been higher. Since they are indicated to be lower, the figures must be in error.

The curves given in Mr. Stevens' paper are very misleading. The coefficient versus throat velocity for conventional Venturi tubes is shown in Fig. 7. Mr. Stevens refers to the point on this curve for 0.5 fps. All of the other curves are plotted on the basis of coefficient versus differential head. Furthermore, the differential scale is not in inches but in feet.

A Venturi tube with a ratio of throat diameter to inlet diameter of 0.5 and a friction coefficient of 0.97 would develop a differential head of .0039 ft. with a throat velocity of 0.5 fps. A point on the upper curve of Fig. 6 at this velocity would be located .002 in. from the center line of the zero ordinate. On the bottom curve of Fig. 6, the point would be located only one half as far from the center line of the zero ordinate. The scale is not marked on the middle curve but presumably it is the same as on the upper curve.

If it had been the intention of the paper to make an actual comparison between conventional and "simplified" Venturi tubes, Figs. 6 and 7 should have been plotted on the same basis. The central curve in Fig. 6 shows three points partly on the zero ordinate, but it is anybody's guess as to whether they are .001 or .002 in. or some other distance from the center line. What is more important is the fact that special equipment is required to accurately measure the differentials at these low rates of flow. As already stated, at 0.5 fps. the differential is equal to .0039 ft. Very special equipment is needed to read the differentials closely enough to prove that the coefficient does not drop a few percent as in Fig. 7.

There are several other indications so that one cannot put complete reliance in any part of the paper. For instance, Mr. Stevens states, "The improved Venturi meter maintains the same velocity distribution in both taps." It is a fact well known by hydraulic engineers and published in numerous books that a converging section makes the velocity distribution in a closed conduit more nearly uniform. Furthermore, any change in velocity distribution requires some distance to take complete effect. In other words the velocity distribution at the throat tap must be more nearly uniform than at the inlet tap. If it is otherwise, there is some phenomenon contrary to commonly known hydraulic facts, and Mr. Stevens should give test results to prove his statement. In the absence of the indication of any tests being run, the statement must be assumed to be in error.

Another statement which casts doubt on the entire paper is the following: "The lowest test point in Fig.

7 corresponds to a throat velocity of 0.5 fps. Laminar flow—an entirely abnormal condition for Venturi tube operation—may have existed in the approach and the larger portion of the reducer." The Reynolds number in the approach to the Venturi tube was approximately 12,000. It is well known that laminar flow in a straight pipe exists at a Reynolds number below 2,000 to 3,000. It is hardly conceivable that it could have existed at a Reynolds number of 12,000.

Further indication that Mr. Stevens has not proved that the "simplified" Venturi tube has a constant coefficient down to lower rates of flow than the conventional Venturi tube is the somewhat wide scattering of test points. Since it was not possible to read the manometers closely enough to locate the points at high rates of flow more nearly on the curves, how could these manometers have been read to .001 or .002 in. of water at the lowest rates of flow?

I. O. MINER
Chief Engineer
Builders-Providence Inc.
Providence, R. I.

Sir: In the article, "A Simpler and Better Venturi Tube" by J. C. Stevens a number of statements are made for which no supporting evidence appears in the text. There are one or two items, however, that we feel forced to comment on.

Under the heading, "Why the Design is More Accurate" it states that a standard commercial Venturi meter operates with a *vena contracta* at the throat and that cavitation represents a normal operating condition for standard Venturi meters. It seems obvious that the writer has performed no actual experiments upon standard designs of Venturi meters and must be relying on inference in arriving at these conclusions.

A 36 x 16-in. Venturi meter is in use at the Alden Hydraulic Laboratory. This tube was originally used to measure water at the World's Fair in Chicago in 1893. After that it was purchased and installed at this laboratory in 1894 and has been in operation ever since.

The maximum pressure existing at the throat of the meter under static conditions is 20 ft. Under flow conditions this pressure is reduced by the friction effects in 350 ft. of 40-in. penstock. The discharges through the meter are such that throat velocities frequently reach 30 fps. and for test conditions attain a maximum of 35 fps. During the 54 years of operation there has never been any evidence of pitting that would indicate cavitation of any severity. It is believed that operating conditions are certainly favorable for the occurrence of cavitation in this meter if this were the normal operating performance of commercial meters.

In this Venturi meter special taps have been constructed permitting velocity traverses of the throat to be made at right angles to flow. Velocity traverses have been made frequently with a pitometer. This instrument accurately measures reverse flow as well as forward flow without a position change. There has never been any evidence of reverse flow in the Venturi throat under any condition.

A statement is made in the original article—"the improved Venturi meter maintains the same velocity distribution at both taps." It is unfortunate that there is no substantiating data confirming this assertion since it is absolutely contrary to what would be expected under the conditions.

In Fig. 7 it would have been most interesting if the test points of the simplified Venturi tube had been plotted on the same graph with the test results ascribed to J. W. Ledoux. It is quite obvious that the accuracies of the experimental work in the two cases were of entirely different orders.

L. J. HOOPER
Professor of Hydraulic Engineering
Worcester Polytechnic Institute
Worcester, Mass.

Sir: My friend, John C. Stevens, is greatly disturbed about contraction in flow which takes place between the conical section and the cylindrical throat of a standard Venturi tube where the angle of divergence is about 10.5 deg. and the radius of curvature is about 3.63 throat diameters.

I would have been remiss if I had not conducted experiments on the effect of varying the radius of curvature. When no radius is used, the coefficient is reduced a little over 0.1 percent, which is probably due to increased loss of head. A radius of one throat-diameter gave the normal coefficient.

The manufacturers of standard Venturi tubes have wisely used the Herschel value for radius of curvature which is given above. This should not surprise Mr Stevens if he will consider the contraction in the limiting element of the jet from a standard orifice in which the coefficient of contraction is 0.61 and the diameter of the jet is 0.78 of the orifice diameter. This limiting element turns through 90 deg. in a radial distance of 0.14 jet diameters and a length of about 0.65 diameters. Yet the coefficient of velocity is very near 0.99 and the velocity traverse is uniform.

A slight rounding at the inner end of standard short tube raises the coefficient of discharge from 0.82 to above 0.98. All I would like to know from him is at what ratio of this radius to throat diameter will contraction disappear. Must we go to infinity?

What is wrong with an accuracy of 0.1 instead of 2 percent? I am quite certain Mr. Stevens would be supremely dissatisfied if one of his excellent transits would not measure 90 degrees nearer than 2 percent.

In the last paragraph of the article Mr. Stevens states, "Venturi tubes in actual service seldom produce results closer than 2 or 3 percent." If he will produce a standard Venturi meter made by either the Builders-Providence, Inc. or Simplex Valve and Meter Co. with such an error, I have no doubt the maker of that particular tube will be happy to hear of it and have it calibrated at their own expense. Otherwise the writer will, for it is a sick meter.

W. S. PARDOE
Professor of Hydraulics
University of Pennsylvania
Philadelphia, Pa.

Correction

The second formula, $y = \frac{W(S/2)^2}{8t}$, printed in H. V. Pittman's article "Construction Cableways on Norfolk Dam" in the 27 December, 1945, issue of *Engineering News-Record* was incorrect. The formula should read, $y = \frac{w(S/2)^2}{8t}$ substituting the small w for large W, the total load.

$w = 24.64 =$ Weight of cable in pounds per foot.

FIELD AND OFFICE

Precast Highway Bridges Cut Construction Costs

Three small concrete highway bridges with a uniform deck thickness were built recently by Broward County, Fla., of members precast at a central yard. Construction costs were cut, and the procedure also permitted rapid erection once work started at the site, thereby reducing traffic interruption in replacing existing structures.

The methods followed proved so successful that the county plans to build several other crossings by similar methods.

All three bridges were designed for an H-15 loading and each provides a clear roadway width of 23 ft. 4 in. One has a span of 10 ft. and the others 16 ft. They were built for a total cost of $15,300, including removal of the timber bridges that were replaced.

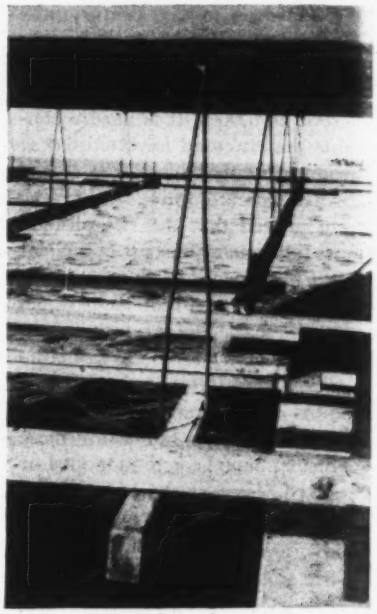
The deck was cast in longitudinal sections 4 ft. 3 in. wide. The curb and parapet were cast as a unit, with a maximum width of 2 ft. 5½ in. Overall depth of the parapet sections was made 3 ft. 10 in. for all three structures, more reinforcing being used for the longer span. Thickness of the roadway slabs varied from 12 in. for the 10-ft. span to 16 in. for the 16-ft. distance. A concrete designed for a minimum compressive strength of 3,500 psi. at 28 days was used for the members of the superstructure.

All forms were of timber and they were assembled on 2-in. planking that served as the bottom form. Weight of the largest unit was 8 tons. At either end of all sections a large screw eye was provided to permit easy handling of the sections, the eyes later being removed after the bridge section was placed in final position.

Foundations for the bridges consist of 12 x 12-in. precast concrete piles. These members are capped with cast-in-place beams, which required the only concrete placed on the job. The abutment and wing walls consist of precast concrete slabs about 8 ft. square and 6 in. thick that bear against the back face of the piling.

The roadway slabs were handled with a crawler crane and before they were set in place a thin layer of cement mortar was added on the bearing surface of the pile caps. Also, grout was used to fill the ½-in. wide groove provided between the tops of the roadway slabs. Once all the roadway members were in place, the upper surface of slabs, which had purposely been given a very rough finish, was covered with a 1-in. thickness of asphaltic concrete.

The bridges were designed and built under the supervision of H. C. Davis, engineer for Broward County. H. L. Mills Construction Co., Miami, for whom W. E. Plude is superintendent, was the general contractor.



LARGE WASHERS welded to the underside of deck girders provide hangers for construction and painting scaffolding beneath the Rickenbacker Causeway, Miami, Fla. The J. E. Griner Co., Baltimore, Md., were engineers for the project.

PRECAST CONCRETE SLABS permit rapid construction of highway bridges and minimize traffic interruption in Broward County, Fla.

ENCASED IN VITRIFIED CLAY PIPES, bent legs of a wood trestle at Bay St. Louis, Miss. have withstood marine-borer attack for more than 30 years. The pipe sleeves, which are seated in the stream bed and extend up to the lowest horizontal brace, are filled with P.C. mortar between shell and leg.

UNIT PRICES BID BY CONTRACTORS

Earthwork and Structures, Coachella, California

OWNER: Bureau of Reclamation, Coachella, California; C. S. Hale, construction engineer.

PROJECT: Earthwork, wasteway lining and structures of Wasteways Nos. 2 and 3 of the Coachella Valley Flood Protection Project, part of the All-American Canal System of the Boulder Canyon Project. Wastway No. 2 is situated about 4 miles east, and Wasteway No. 3, about 4 miles north, of Coachella. California. Earthwork includes 395,600 cu. yds. of excavation for wasteway channel and structures. Structures include two chutes and stilling pools, a culvert, a bridge and steel piles for abutments of a future bridge.

CONDITIONS: Among the materials furnished by the government are: wire reinforcement fabric for concrete lining in drains; rubber water stops; metalwork for baffle blocks in stilling pools; metal pipe for weep holes; and metalwork for strap supports for sewer-pipe drains. Access to job site is available by highway. Stipulated contract time is 450 days from date of notice to proceed. Prevailing labor wage rates per hr. are:

LIST OF BIDDERS. * Contract awarded

1. *Macco Corp., Clearwater, Calif. (contract) $605,655.00
2. Fisher Contr. Co., Phoenix, Ariz. 609,900.40
3. Norman I. Fadel, North Hollywood, Calif. 648,554.00
4. The Shea Co., Alhambra, Calif. 697,615.00
5. V. D. Case Co., Long Beach, Calif. $698,545.50
6. Claude Fisher Co., Ltd. and L. A. & R. S. Crow, Los Angeles, Calif. 736,856.00
7. Otto B. Ashbach & Sons, Inc. and Steenberg Const. Co., St. Paul, Minn. 755,643.50
8. United Engineers, Inc., Ogden, Utah (bid on Section I only) $347,490.00
9. Hubert H. Everist, Sr., Westley, Calif. 794,307.90
10. Dimmitt & Taylor and T. M. Page, Los Angeles, Calif. 794,491.50

Item	Quantity	Unit Prices (1) *	(2)	(3)
Schedule I:				
1 Excavation for wasteway channel	246,000 cy	$0.22	$0.25	$0.20
2 Excavation for structures	9,400 cy	1.00	.29	.85
3 Compacting embankments	1,400 cy	.50	1.25	.45
4 Overhaul	100,000 st cy	.01	.01	.015
5 Backfill about structures	1,900 cy	.30	.87	.25
6 Backfill about wasteway sidewalls	5,300 cy	.30	.15	.30
7 Compacting backfill	600 cy	3.00	3.60	2.00
8 Trimming foundations for wasteway lining	21,700 sy	.40	.32	.40
9 Riprap	1,500 cy	4.00	3.60	6.00
10 Furnishing materials and constructing reverse filter	400 cy	7.00	5.00	10.00
11 Furnishing and placing 6" pipe in reverse filter	470 lf	2.50	1.17	1.50
12 Concrete in structures	710 cy	41.00	35.75	39.00
13 Concrete in wasteway lining	3,700 cy	17.00	21.85	21.75
14 Furnishing and handling cement	6,160 bbl	4.00	4.00	4.40
15 Furnishing and placing reinforcement bars	429,000 lb	.10	.085	.10
16 Furnishing and erecting timber in structures	63 M bm	300.00	200.00	200.00
17 Furnishing and driving timber bearing piles	690 lf	4.00	2.85	3.25
18 Furnishing and driving structural steel bearing piles	450 lf	4.00	5.00	5.75
19 Installing miscellaneous metalwork	2,800 lb	.20	.19	.50
Schedule II:				
20 Excavation for wasteway channel	125,000 cy	.22	.27	.20
21 Excavation for structures	15,200 cy	1.00	.29	.85
22 Compacting embankments	1,000 cy	.50	1.25	.45
23 Overhaul	5,000 st cy	.01	.015	.01
24 Compacted subbase	120 cy	1.00	6.30	2.00
25 Backfill about structures	4,400 cy	.30	.87	.25
26 Backfill about wasteway sidewalls	8,400 cy	.30	.15	.30
27 Compacting backfill	1,500 cy	3.00	3.60	2.00
28 Trimming foundations for wasteway lining	32,700 sy	.40	.32	.40
29 Riprap	5,000 cy	4.00	3.60	6.00
30 Furnishing and constructing pit-run gravel blanket	50 cy	5.00	3.41	10.00
31 Furnishing materials and constructing reverse filter	230 cy	7.00	5.00	10.00
32 Furnishing and placing 6" pipe in reverse filter	310 lf	2.50	1.30	1.50
33 Concrete in structures	1,120 cy	41.00	37.15	39.00
34 Concrete in wasteway lining	5,500 cy	17.00	21.63	21.75
35 Furnishing and handling cement	9,250 bbl	4.00	4.00	4.40
36 Furnishing and placing reinforcement bars	630,000 lb	.10	.085	.10
37 Furnishing and placing elastic filler in joints	460 sf	1.00	1.50	1.00
38 Placing rubber water stops in joints	470 lf	1.00	2.50	1.00
39 Constructing concrete-lined drain ditches	350 lf	2.50	2.20	8.00
40 Furnishing and erecting timber in structures	14 M bm	360.00	250.00	200.00
41 Installing miscellaneous metalwork	2,800 lb	.20	.19	.50

Road and Bridge Bypass, Plymouth, Mass.

OWNER: Commonwealth of Massachusetts, Boston, Mass.; Massachusetts Department of Public Works, engineer.

PROJECT: Construction of 9400 ft. of bituminous macadam highway and reinforced concrete beam and slab bridge on the Plymouth bypass, Plymouth, Mass. The bridge to pass over Somoset St.; The pavement width to be 24 ft. to 56 ft. Work includes excavation, drainage, grading, water system changes, and installation of highway guard rail.

CONDITIONS: The owner will furnish 12 in. cast iron pipe and necessary fittings, all other materials furnished by contractor. Access to the job site is available by rail, highway, and water. Stipulated contract completion date is July 1, 1949. Prevailing hourly wage rates are: skilled, $1.75 to $2.175; semi-skilled, $1.10 to $1.80; common, $.75 to $1.25.

LIST OF BIDDERS: *Contract awarded May 13, 1948

1. *The Lane Construction Corp., Meridan, Conn. $539,338.25
2. Baver & Mingolla Construction Co., Inc., Worcester, Mass. 551,674.50
3. B. Perini & Sons, Inc., Framingham, Mass. 647,308.50

Items	Quantity	Unit Prices (1)*	(2)	(3)
1 Clearing and grubbing	40 acres	$300.00	$500.00	$200.00
2 Roadway earth excavation	339,000 cy	.30	.32	.42
3 Rock excavation, class A	400 cy	.30	2.50	2.75
4 Peat excavation	6,400 cy	.30	.40	.60
5 Bridge excavation	700 cy	2.00	1.50	1.40
6 Trench excavation	6,000 cy	2.50	1.50	2.00
7 Rock excavations, class B	135 cy	2.50	8.00	2.00
8 Ordinary borrow	8,200 cy	.20	.20	.50
9 Gravel borrow	36,000 cy	.30	.60	.80
10 Sand borrow	1,750 cy	4.00	3.00	2.40
11 Stripping gravel pits	3,700 cy	.05	.20	.14
12 Fine grading, rolling and finishing	222,000 sy	.12	.10	.11
13 Crushed stone for base course	12,700 tons	3.50	3.60	4.15
14 Bitumen for roadway base course	2,200 gal	.15	.15	.15
15 Calcium chloride for surface treatment	2,000 lb	.05	.05	.05
16 Gravel for surfacing	750 cy	1.25	1.50	1.40
17 Bitumen for surface treatment	3,600 gal	.15	.18	.18
18 Crushed stone for macadam surfacing	8,450 ton	4.25	3.90	4.25
19 Bitumen for macadam surfacing	133,000 gal	.15	.15	.15
20 Bit. conc. pavement type I-1, class 1	330 ton	10.00	9.00	8.00
21 Cement concrete masonry, class A	1,351 cy	55.00	45.00	58.50
22 Cement concrete masonry, class C	45 cy	40.00	40.00	58.50
23 Steel reinforcement for structures	220,100 lb	.09	.08	.15
24 Structural steel	10,500 lb	.23	.20	.30
25 Membrane waterproofing	965 sy	2.25	2.50	2.50
26 Bituminous damp-proofing	30 sy	.50	1.00	.40
27 Metal bridge railings	533 lf	17.50	19.00	18.00
28 Steel piles	2,700 lf	4.00	7.00	8.15
29 Steel pile splices	2 ea	75.00	100.00	60.00
30 Catch basins	61 ea	165.00	150.00	160.00
31 Manholes	14 ea	165.00	150.00	160.00
32 Manholes (9' to 14' depth)	3 ea	250.00	300.00	270.00
33 Leaching basins	2 ea	165.00	200.00	160.00

Continued on page 121

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...the smooth, dependable, easy-holding power of LE ROI-CLEVELAND Sinker reduces drilling costs by drilling more feet of hole per shift—for more shift

Power for fast drilling in hard rock; power that rotates the steel in "fitchery" formations; power that cleans the hole and improves performance — you get all kinds of power in Le Roi-Cleveland 45-lb. H-10 and 55-lb. H-111 sinkers.

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And, it is dependable power. The working parts are carefully designed to provide the strongest possible sections — they are heat-treated by men who have more than 40 years of heat-treating experience behind them — and they are enclosed and protected by durable drop forgings.

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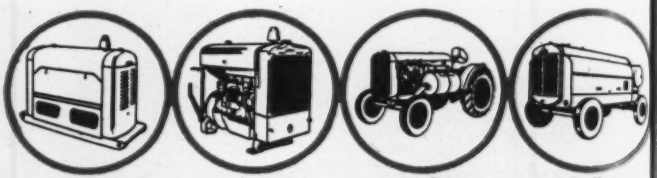

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Road and Bridge Bypass, Plymouth, Mass.

Continued from page 119

34 Reinforced concrete pipe, 12"	5,020 lf	2.00	2.10	2.25
35 Reinforced concrete pipe, 15"	1,620 lf	2.50	2.60	2.90
36 Reinforced concrete pipe, 18"	940 lf	3.25	3.70	3.75
37 Reinforced concrete pipe, 24"	230 lf	4.75	5.50	5.50
38 Reinforced concrete pipe, 30"	630 lf	5.75	6.50	7.25
39 Pipe culverts rem. and stacked, 12"	85 lf	1.50	1.00	1.40
40 Pipe culverts rem. and stacked, 16"	65 lf	1.50	1.00	2.00
41 Bituminous mixture paving (waterways)	300 sy	2.25	2.50	2.25
42 Highway guard type C3S	6,000 lf	1.35	1.45	1.60
43 Highway guard end anchors C3S	32 ea	40.00	40.00	45.00
44 Highway guard intermediate anchors C3S	6 ea	40.00	43.00	45.00
45 Highway guard bridge anchors C3S	2 ea	30.00	45.00	35.00
46 Stock fence	21,400 lf	.35	.35	.40
47 Individual posts	230 ea	5.50	6.50	7.50
48 Highway guard removed and reset	1,200 lf	.80	.85	.90
49 Anchors removed and reset	8 ea	7.50	20.00	6.00
50 Highway guard removed and stacked	230 lf	.50	.30	.25
51 Barrier fence	100 lf	6.00	6.00	8.50
52 Fences removed and reset	170 lf	.50	.60	.45
53 Granite curb type VA4 straight	400 lf	2.25	2.50	3.00
54 Granite curb type VA4 curved	50 lf	3.50	3.20	3.65
55 Granite curb type VB straight	1,600 lf	2.15	2.40	2.70
56 Granite curb type VB curved	140 lf	3.00	3.00	3.40
57 Granite curb type VA str. (6" x 7½")	266 lf	2.50	3.00	3.25
58 Granite curb type VA str. (6" x 12")	266 lf	2.50	3.00	3.25
59 Granite edging type SB straight	5,800 lf	1.60	1.80	2.00
60 Granite edging type SB curved	220 lf	2.25	2.50	2.70
61 Granite edging type SFA (12" x 9")	266 lf	4.25	5.00	5.75
62 Granite curb inlets	23 ea	25.00	24.00	30.00
63 Granite curb corners type A	5 ea	15.00	20.00	17.50
64 Granolithic walks	10 sy	3.00	5.00	4.00
65 Bit. conc. walk surface, type I-1, type I-2	120 ton	11.00	10.00	10.50
66 Traffic signal conduit, type B for CA	1,150 lf	1.00	.70	1.00
67 Identification signs furnished and set	2 ea	35.00	75.00	85.00
68 Bounds furnished and set (plain granite)	75 ea	18.00	18.00	19.00
69 Bounds furnished and set (lettered granite)	40 ea	22.00	22.00	24.00
70 Bounds removed and reset	3 ea	15.00	15.00	14.00
71 Bounds removed and stacked	5 ea	10.00	5.00	11.00
72 Rural mail box removed and reset	1 ea	15.00	10.00	7.00
73 Portable field office	Lump Sum	250.00	1,500.00	1,800.00
74 Flashing beacon	Lump Sum	1,400.00	1,700.00	1,600.00
75 Traffic signals	Lump Sum	1,400.00	1,700.00	1,600.00
76 Topsoil exc., stacked and rehandled	24,000 cy	1.25	1.25	1.65
77 Seeding	84,000 sy	.08	.08	.10
78 Field sodding	650 sy	1.25	1.20	1.40
79 Mulching	60,000 sy	.08	.08	.10
80 Topsoil borrow	1,500 cy	1.50	1.70	1.40
81 Cast iron water main rem. and relaid, 6"	380 lf	2.50	2.50	2.00
82 Cast iron water main rem. and relaid, 8"	850 lf	3.00	2.50	2.75
83 Cast iron water main rem. and relaid, 12"	750 lf	3.00	1.00	4.15
84 Hydrants removed and reset	3 ea	50.00	100.00	55.00
85 Temporary service pipe, 2½"	1,200 lf	.50	1.25	1.75
86 Gate and gate box, 6"	1 ea	90.00	100.00	100.00
87 Gates and gate boxes, 8"	4 ea	115.00	130.00	145.00
88 Gates and gate boxes, 12"	2 ea	200.00	250.00	265.00

Sanitary and Storm Sewers, Burlington, Wis.

OWNFR: City of Burlington, Wisconsin; Lester O. Hoganson, city engineer.

PROJECT: The construction of sanitary and storm sewers. The sanitary sewers to have an average depth of 8.5 feet and the storm sewers, 5.0 feet. On relay jobs, the contractor must take care of all sewage while existing sewer is replaced.

CONDITIONS: All materials to be furnished by contractor. Access to the job site available by both rail and highway. Stipulated contract time is eight months. Prevailing wage rates are; skilled, $1.90 per hour, semi-skilled, $1.40 per hour, and common $1.00 per hour.

LIST OF BIDDERS: *Contract awarded June 1, 1948

1. *Wm. J. O'Neill, Lake Geneva, Wis. $50,823.50
2. James Construction Co., Milwaukee, Wis. 54,565.22

Item	Quantity	Unit Prices (1)*	(2)
1 Sanitary sewer in Delevan St.—8 in	347 ft	$3.00	$3.10
2 Sanitary sewer in Origin St.—8 in	136 ft	3.50	3.97
3 Sanitary sewer in Edward St.—8 in	355 ft	4.00	4.25
4 Sanitary sewer in Mary St.—8 in	355 ft	4.00	4.25
5 Sanitary sewer in Alice St.—8 in	183 ft	3.50	3.80
6 Sanitary sewer in Market St.—8 in	269 ft	3.50	3.80
7 Sanitary sewer in Kane St.—8 in	355 ft	3.50	3.70
8 Sanitary sewer in E. Water St. (relay)—12 in	330 ft	6.50	7.10
9 Sanitary sewer in Brody St.—8 in	762 ft	3.50	3.70
10 Sanitary sewer in Washington St. (relay)—12 in	1,187 ft	9.00	9.50
11 Sanitary sewer in Washington St. (relay)—12 in	353 ft	10.00	11.00
12 Sanitary sewer in Washington St.—8 in	212 ft	4.00	4.00
13 Tunnel, 2–8 in pipes under tracks in Washington St	108 ft	30.00	35.00
14 Sanitary sewer in Calumet St.—8 in	93 ft	3.00	2.90
15 Sanitary sewer in Jefferson St.—8 in	290 ft	6.00	5.80
16 Sanitary sewer in Chestnut St.—8 in	195 ft	6.00	5.80
17 Sanitary sewer in Mutter Ave.—8 in	354 ft	3.50	3.50
18 Sanitary sewer in North St.—10 in	413 ft	4.00	4.10
19 Sanitary sewer in Milwaukee Ave.—10 in	1,122 ft	6.00	6.60
20 Sanitary sewer in Milwaukee Ave.—8 in	560 ft	5.00	5.70
21 Storm sewer at Livingston & Kane Sts.—12 in	55 ft	3.00	3.00
22 Corr. pipe storm sew. at Livingston & Kane Sts. 10 in.	45 ft	4.00	3.50
23 Storm sewer in Madison St.—12 in	348 ft	3.00	3.00
24 C. B. leads—10 in	10 ft	2.00	3.00
25 C. B. leads (relay)—10 in	45 ft	4.00	5.00
26 Conc. block catch basins incl. fr. & grates	2	20/ft	20/ft
27 Concrete block manholes incl. fr. & covers	31	15/ft	16.50/ft
28 Conc. block drop manhole	1	20/ft	20/ft
29 Drop legs cut into 3 existing manholes—8 in	20 ft	3/ft	3.50/ft
30 House sewer connections	22	10/ea	12/ea

Fairground Improvements, Solano County, Calif.

OWNER: Solano County Fair Association, Vallejo, California; Solano Engineers Associated, engineers.

PROJECT: Grading involving 324,223 cubic yards of excavation, constructing drainage structures including 64 linear foot 18x11 inch arch culvert, installing 11,038 linear feet of 7-foot fencing and 1041 linear feet of 4-foot fencing.

CONDITIONS: All materials to be furnished by the contractor. Access to the job site is available by highway. Stipulated contract time is 128 days. Prevailing hourly wage rates are: skilled, $1.50; semi-skilled, $1.40; common, $1.40.

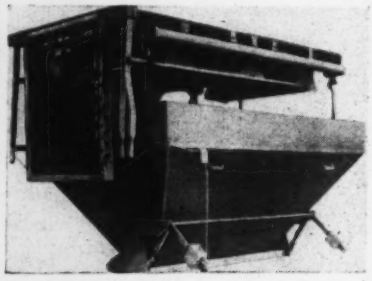
LIST OF BIDDERS: *Contract awarded May 26, 1948

1. *George R. Patterson, Stockton, Calif. $135,714.94
2. J. O. Archibald, Redwood City and Sondroth Bros., Mt. View, Calif. 164,544.70
3. Malfitano & Son, Inc. and Macal Impt. Co., Pittsburg, Calif. 175,838.00
4. Parish Bros, Benicia, Calif. 183,752.97
5. Chas. L. Harney, San Francisco, Calif. 226,098.22
6. C. M. Syar and A. R. McEwen, Vallejo, Calif. 244,710.89
7. Westbrook & Pope, Sacramento, Calif. 252,061.89
8. H. Earl Parker, Marysville, Calif. 273,493.32

Item	Quantity	Unit Prices (1)*	(2)	(3)
1 Excavation	324,223 cy	$ .22	$ .274	$ .33
2 Develop water supply	lump sum	9,000.00	2,100.00	1,500.00
3 Applying water	9,000 M gals	.50	2.30	1.00
4 Corru. metal pipe—18 in	64 lf	2.75	4.20	5.00
5 Corru. metal pipe—30 in	280 lf	6.00	7.20	7.00
6 Corru. metal pipe—42 in	234 lf	10.25	11.30	12.00
7 Corru. metal pipe—48 in	798 lf	12.00	12.70	13.00
7a Corru. metal pipe arch culvert—18 x 11 in	64 lf	2.50	4.00	4.00
8 Corru. metal pipe arch culvert—25 x 15 in	272 lf	4.50	7.85	6.00
9 Liquid asphalt SC-1, prime coat	1 ton	30.00	42.00	40.00
10 Plant mix surfacing	30 tons	25.00	15.00	10.00
11 Reinf. conc. structures	31.1 cy	60.00	71.00	60.00
12 Rubble masonry struc	208 cy	50.00	54.60	40.00
13 Race track rail	9,175 lf	.86	.65	.90
7-ft. High Metal Chain Link Fence Installed				
14 Fence	11,038 lf	1.09	1.14	1.70
15 Gates	88 lf	5.00	5.25	6.00
16 OD end posts complete with fittings—3 in	1 ea	11.00	12.00	13.61
17 OD square—2½ in. or OD round—3 in. corner posts complete with fittings	24 ea	14.00	15.00	17.00
18 OD square—2½ in. or OD round—3 in. corner posts complete with fittings	2 ea	11.00	11.65	13.00
19 OD square—3 in. or OD round—4 in. corner posts compl. with fittings	14 ea	15.00	15.55	18.00
20. OD round gate posts complete with fittings—6½ in.	2 ea	33.00	35.00	40.00
21 Remove panel for ditch crossings 4-ft. High Metal Chain Link Fence Installed	98 lf	4.20	4.41	6.00
22 Fence	1,041 lf	.96	1.01	1.30
23 Gates	28 lf	4.00	4.20	4.70
24 OD end posts complete with fittings 2½ in	4 ea	6.50	6.82	4.70
25 OD corner posts compl. with fittings 2½ in	2 ea	8.75	9.00	4.70
26 OD gate posts compl. with fittings 2½ in	1 ea	6.50	6.82	4.70

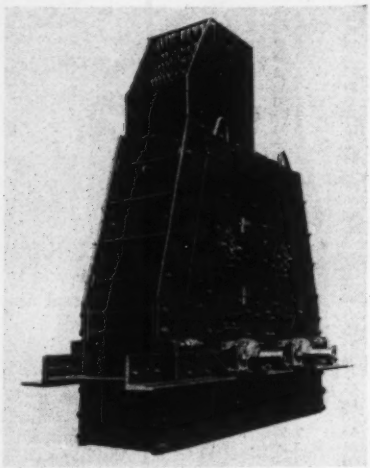
NEW PRODUCTS

ROTARY CONCRETE DRILL—Depending upon a rotary pulverizing action rather than on sharp cutting edges or hammer-like blows, this new Concrete Termite rotary drill makes straight, clean, true holes through any masonry-like material very efficiently. The concrete termites are used with any electric drill and no water is necessary. With ½-in. drill 3 inches of concrete can be drilled in less than 50 seconds. Drills are available in 1/16-in. sizes for ½-in. to 1½-in. dia. There is an extra-length shank up to 3 ft. long.—*Concrete Termite Drill Co., 1627 E. Walnut St., Pasadena 4, Calif.*



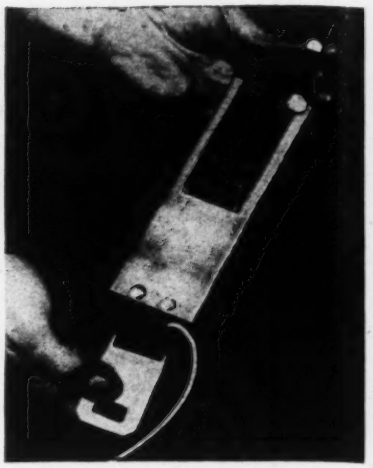
HI-SPEED BATCHER—Designed for batching all aggregate materials on a single scale, the Hi-Speed batcher is generally used in connection with tandem bins. A one unit beam box contains scale levers, weigh beams and indicator, and a built-in damper on a sensitive indicator reduces scale beam oscillation. The batcher has minimum height and wide bin openings to accommodate extra wide fill valves for high speed operation.—*C. S. Johnson Co., Champaign, Ill.*

CONCRETE PAVING FINISHER—Independent control of traction and screeds is provided by new automotive type transmission. Selective control provides operator with sixteen combinations of screed and traction speeds, claimed to be an advantage in finishing air-entrained concrete. Equipped with 27-hp. engine and with vibratory paving attachment. There is a quick adjustment for crown and the screeds have a telescopic width adjustment. End trucks of unit type are moved over on main structural members for width changes. V-belt drive with automatic take-up absorbs shock of starting and stopping. Machine has hydraulic screed lifting system—*Blaw-Knox Co., Pittsburgh, Pa.*

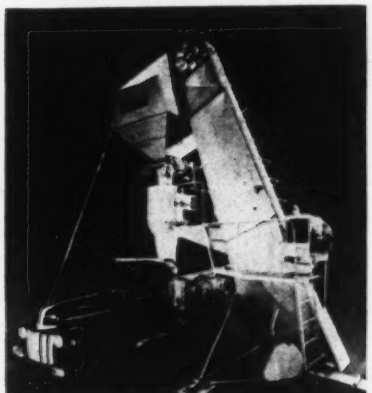


DOUBLE IMPELLER BREAKER—The 20,000-lb. model 2020 Breaker will produce cubical crushed aggregate from any material not exceeding 20x20x36 in. Two 2930-lb. impellers spin in opposite directions, keeping the machine stable. Each impeller is equipped with three 265-lb. manganese steel bars, and alloy steel shafts have a 4 1/16-in. dia. at the core and 3 7/8-in. at the bearings. With a 50 to 135-ton-per-hour capacity, the 2020 operates on 50 to 100 hp.—*New Holland Machine Co., Mountville, Pa.*

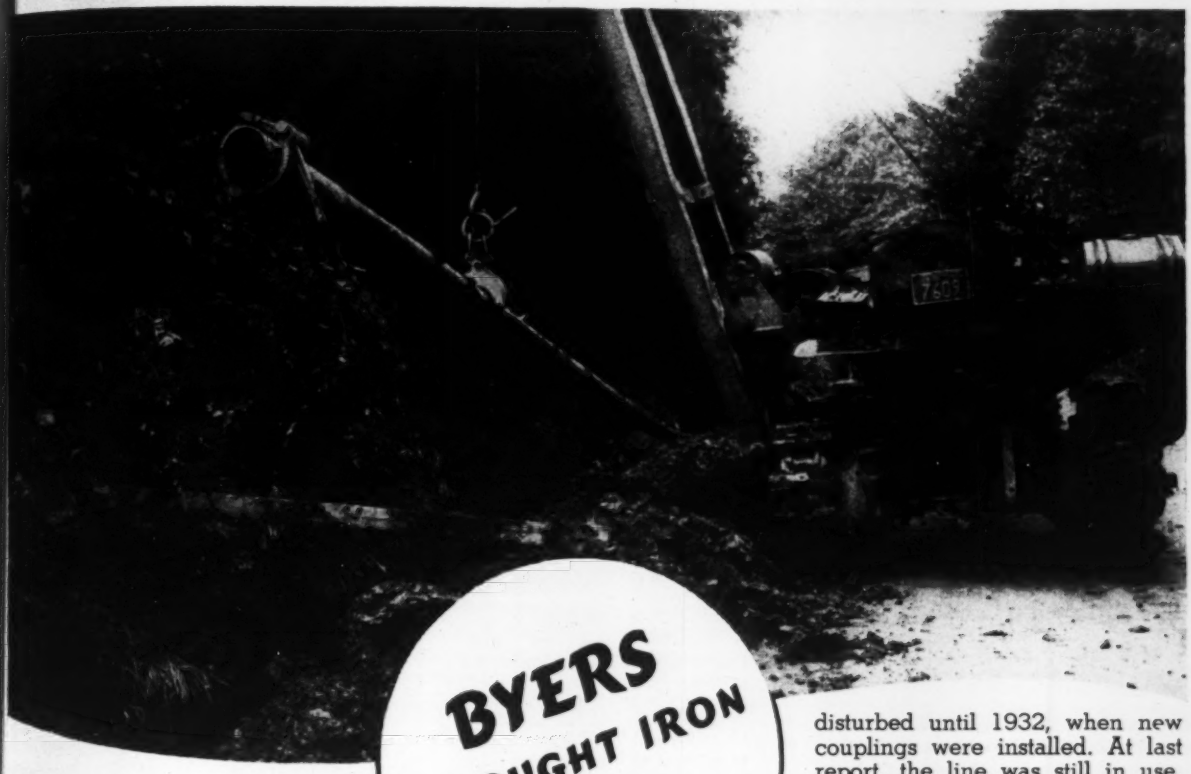
JEEP HYDRAULIC SCOOP—Speeding ditching and ditch cleaning, a 6-ft. capacity hydraulically controlled steel scoop can be attached to any jeep equipped with the Monroe hydraulic lift. Constructed with a heavy welded steel frame and reinforced forged cutting blade, the scoop can be attached or removed from the three-point hitch by one man in a few minutes. The lift provides an adjustable down pressure of 1 to 500 lbs. Pitch is controlled by the top link, and angle of cut is regulated by lifting arm adjusting screws. Scoop is dumped by a release rope at the driver's seat and returns automatically to reloading position.—*Newgren Co., 730 Phillips Ave., Toledo 12, Ohio.*



BELT-CARRIED SHOT FIRER—A capacitor-operated, 10-shot firer for blasting offers safety features and can be carried on and fired from the belt if desired. Charge is transferred to two condensers and then to explosive by a special safety key which prevents accidental discharge. The unit weighs slightly over one pound. Safety features include automatic charge dissipation if not used; recessed terminals, non-metallic, non-conducting case and neon light indicating when unit is ready to fire.—*Farmers Engineering and Mfg. Co., 549 Brushton Ave., Pittsburgh 21, Pa.*



ELEVATING CEMENT CHARGER—Used as a portable plant for unloading cement from box cars or hopper bottom cars, an elevating cement charger can be moved and set-up without auxiliary equipment. A standard dump truck transports and is employed in creating the one-piece unit. Standard equipment with this charger includes gasoline engine or electric drive, a 1000-lb. capacity weigh batcher, box car receiving hopper, a 10-in. dia. adjustable height screw conveyor and a small air compressor for cement aeration. Capacity is 300 bbl. per hr. with buckets 80 per cent filled.—*C. S. Johnson Co., Champaign, Ill.*



BYERS WROUGHT IRON PIPE

helps to end gas shortages

and maintenance threats

Like other alert and progressive gas utilities, the Manufacturer's Light and Heat Company of Pittsburgh, Pa., is conducting a major program aimed at increasing the available supply of gas, and extending its use to additional customers. One phase of this activity is shown in the photograph, where a low pressure line of 6-inch Byers Wrought Iron pipe is being installed to serve a new housing development. A large amount of Byers Wrought Iron pipe has also been used for transmission and distribution lines.

PROVEN RELIABILITY

Byers' records of old installations certify the durability of wrought iron in services like these. An 8-inch wrought iron pipe line, originally extending from West Point, Ky., to Louisville, Ky., was relocated after 50 years of service. The pipe was in such good condition that it was relaid; no leaks could be found. In another installation, a 16-inch line in West Virginia laid in 1895, served undisturbed until 1932, when new couplings were installed. At last report, the line was still in use, and considered by the owners as one of the most reliable in their network.

WHY WROUGHT IRON LASTS

Wrought iron's unusual service qualities come from its unusual composition and structure. Tiny threads of glass-like silicate slag, threaded through the body of high purity iron, halt and "detour" corrosive attack. They also help anchor the initial protective scale, which shields the underlying metal.

WANT MORE FACTS?

Our bulletin, "Wrought Iron for Underground Services" is filled with sound, practical information on the corrosive conditions encountered, and with reports of engineer-experience with wrought iron. We will be glad to send you a copy, on request.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Salt Lake City, Seattle, San Francisco. Export Division: New York, N. Y.

CORROSION COSTS YOU MORE THAN WROUGHT IRON

BYERS

GENUINE WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

How to get the best service on contract bonds

When you are preparing to bid on a job . . . and you know you will need a bond . . .

Call on an organization where the underwriters are thoroughly familiar with your problems . . . where field men with experience are equipped to apply special action in special cases . . . where you can depend on prompt, efficient, intelligent service.

Call on an organization with nation-wide facilities . . . an organization able to supply bonds that are readily acceptable on public or private work in any part of the country.
In short . . .

Call on the Ætna representative in your community. He will put at your service the experience, the reputation and the organization of one of the nation's leading surety companies.

But when you call him, call him *early*. The more *time* you give *him*, the more *service* he can give *you*.

IT'S NEVER TOO EARLY
TO CONSULT WITH YOUR SURETY

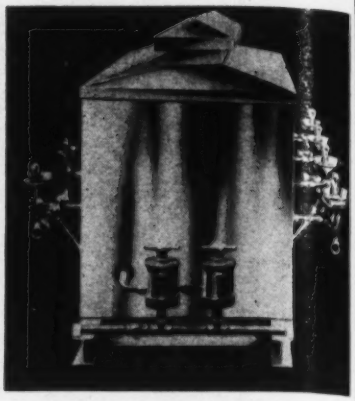
Agents from coast to coast

Ætna Casualty and Surety Company

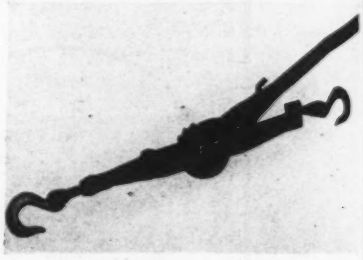
Affiliated with Ætna Life Insurance Company

Automobile Insurance Company • Standard Fire Insurance Company

HARTFORD 15, CONNECTICUT



MOBILE WATER COOLER—Helping to raise morale and speed the job, a 25-gal. mobile water cooler housed in a 60 x 30 x 24-in. weatherproof, stainless steel cabinet is available with up to 8 sanitary bubblers. Clarity and excellent water taste are assured by self-contained filter-dechlorinators. Rugged construction and I-beam mounts enable truck or mobile carrier transportation, and the cooler may be operated by electrical or gas-engine power.—*Filtrine Mfg. Co., 53 Lexington Ave., Brooklyn, 5 N. Y.*



ONE-MAN HOIST—A 6-lb. one-man hoist with a ¾-ton capacity eliminates heavy chain hoist in most cases. Pow'r Pull is available with various cable lengths.—*American Gage & Manufacturing Co., 125 Bayard St., Dayton 1.*

FLOOD LAMP—Designed for heavy-duty use on mobile equipment, Sturdilite provides high intensity and spread with a sealed-beam unit. Features are an 18-gage steel case, spring-mounted socket with compression springs and vibration-absorbing mounting base, floating in rubber. Models are available in 4-6, 12-16, and 110-120 volts.—*Phoenix Products Co., Metal Spinning Division 4715 N. 27th St., Milwaukee 9, Wis.*

TANDEM AXLE DUMP TRAILER—With a payload up to 50 percent greater than single axle trailers, a tandem axle dump trailer is relatively light despite its size. Payload distribution is 34 percent on king pin and 66 percent on

PMCO

America's Largest Builder of Material Handling Buckets

All Purpose

SHOVEL
PULL SHOVEL
DRAGLINE
CLAMSHELL

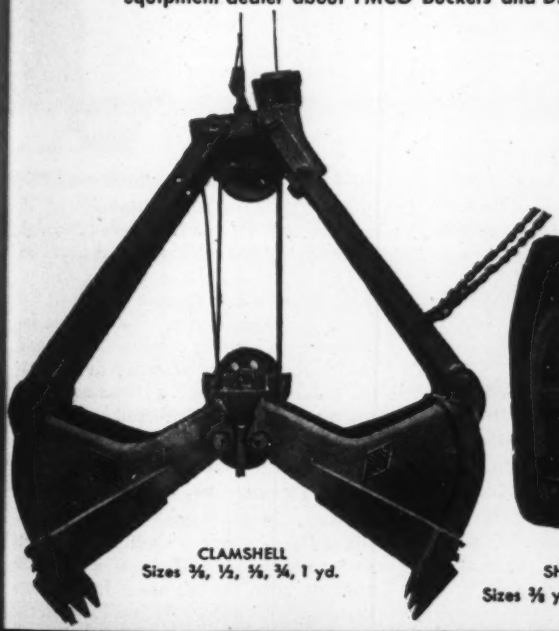
FRONTS, BOTTOMS, SCOOPS and TEETH shown in color on buckets are 14% manganese steel developing tensile strength up to 120,000 p.s.i. This high percentage manganese steel gives tough, rugged strength for hard service and allows wide set corner teeth for easy entrance in digging. Volume production methods enable us to build a better bucket with amazing economies in manufacturing.

Experience Counts. See your shovel man or equipment dealer about PMCO Buckets and Dippers.

DRAGLINE
Perforated Sizes ⅜ yd. to 2 yds. 20%-40% lighter than other makes.
Solid Sizes ⅜ yd. to 2 yds.
Mine Stripping Sizes 2 yds. to 9 yds

PULL SHOVEL
Outside Cutter Widths:
21", 26", 31", 36", 39"

On the ½ yd. and ¾ yd. Shovel, Pull Shovel, and Dragline Buckets, all teeth are interchangeable—a great advantage to operators.



CLAMSHELL
Sizes ⅜, ½, ⅝, ¾, 1 yd.

SHOVEL
Sizes ⅜ yd. to 18 yds.

"Quality Since 1880"

PETTIBONE MULLIKEN CORP. CHICAGO 51, U. S. A.

WE OPERATE THE LARGEST AND MOST COMPLETE MANGANESE STEEL FOUNDRY IN THE UNITED STATES

Bertha... "THE SEWING MACHINE GIRL" is really cozy now !

How to keep 25,000 square feet of unbroken floor area warm enough that women's fingers could keep pace with high speed sewing machines, even on coldest days? Mr. M. M. Barry, manager of the Connellsville Sportswear Company, a garment manufacturing plant in Connellsville, Pennsylvania, had this seemingly expensive heating problem to solve.

Mr. Barry found a simple, low-cost solution by providing heat directly at working level with Dravo *Counterflo* Heaters. Four heaters, one on each wall, blanket the factory working area with a draft-free "cross-fire" of warm air above the heads of the workers. Heat distribution is uniform at 72 to 75 degrees throughout.

Completely automatic, the Dravo *Counterflo* Heaters require only a fuel line, power line and short vent stack—no boiler room. The thermostat is lowered or shut off completely at night for additional, important economies.

Dravo heaters produce warm air quickly. Sturdy, carefully engineered construction, plus a stainless steel combustion chamber, minimize maintenance cost. Equally efficient with oil or gas, sizes ranging from 400,000 to 2,000,000 BTU per hour output are available. A touch of the selector switch converts them immediately to high-capacity air-circulating units for summer use.

If you would like more information to help solve your own heating problems, write for Bulletin JF-516, Heating Section, Dravo Corporation, Dravo Building, Pittsburgh 22, Pennsylvania.

Living room comfort speeds production and cuts absenteeism in this modern garment manufacturing plant. As the manager, Mr. Barry says, "Women employees cannot be expected to operate sewing machines properly if their hands and feet are cold or if they are otherwise uncomfortable."

Dravo also manufactures the DRAVO CRANE CAB COOLER for air conditioning hot-metal crane cabs

DRAVO CORPORATION

Sales Representatives in Principal Cities

PITTSBURGH • CLEVELAND • PHILADELPHIA • DETROIT
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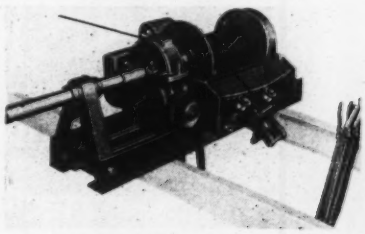
DRAVO

tandem axle unit. Inside body length is 20 ft. and sides and front are 60 in. high. Twin cylinder hoists provide a 45-deg. dumping angle. — *McCabe Powers Auto Body Co., St. Louis 15, Mo.*



TRUCK WINCH—A spooling and tension device eliminates cable damage or breakage from loose and crossed coils in the Reel-Rite truck winch. The spooling unit is not mechnically linked to the winch drive, so it automatically compensates for any change in rope diameter, speed or wear. Winch also has detachable back draft clutch, heat treated alloy steel shafts, ball bearing mounted worm, automatic safety brake and patented flexible suspension. Capacity is 20,000 lbs.—*Gar Wood Industries, Inc., Findlay Div., Findlay, Ohio.*

POWER WHEELBARROW — The Moto-Bug has a rated capacity of 10 cu.ft. or 1000 lb. and is powered through V-belt drive and fully enclosed gears by an air-cooled 3.9 hp. gasoline engine. With forward and reverse speeds of 2-4 mph., the wheelbarrow features an instantaneous gravity dump body and chain stop, an easy steering device, 33-in. maximum width, a front-axle differential and rubber-tired wheels.—*Kwik-Mix Co., Port Washington, Wis.*

LIFT TRUCK—Placing the operator crossways in the Wagnemobile Duo-Way lift enables improved visibility, comfort, and control. Mounted on a tri-cycle running gear, the lift has a front wheel drive with 900x20 dual tires. Hydraulic power steering is adapted to the tail wheel. The lift has a 16,000-lb. rated capacity and weighs 14,500 lbs. The track is pivot mounted at its base, providing for 7-deg. forward tilt and 15 deg. to the rear. Constructed in two sections, the top section is hydrau-

Adams advantages pay off for Morrison-Knudsen!

The extension of the Los Angeles Airport by Morrison-Knudsen was a soil-cement job involving exacting operations—grading, mixing, spreading and finishing.

One of the busiest machines on this M-K job was the Adams Motor Grader pictured above. First of all, the machine handled the original sub-grading. Then came windrowing of the material for the mixing machine. Lastly, the soil-cement mix was spread and finished to rigid specifications.

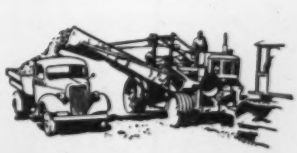
To finish fast-setting soil-cement mix to exacting specifications calls for working at highest possible speeds, plus real precision control. Adams 8 overlapping forward speeds, coupled with positive-acting mechanical controls, provided exactly the right combination to meet every requirement of this M-K job. And you can depend on it—Adams advantages pay off in a big way on every type of grading operation. For full information on the world's most complete line of motor graders, see your local Adams dealer.

J. D. ADAMS MANUFACTURING CO. • INDIANAPOLIS, INDIANA

ONLY ADAMS OFFERS ALL THESE OUTSTANDING ADVANTAGES

- 8 Overlapping Forward Speeds
- High-Arch Front Axle for Clearance
- Push-Button Starting from Cab
- Positive Mechanical Controls
- Wide Range of Blade Adjustments
- Exceptional Blade Clearance In All Operating Positions
- Balanced Weight Distribution
- Easy Access for Fast Servicing
- World-Wide Dealer Service

Adams



MOTOR GRADERS • LEANING WHEEL GRADERS • ELEVATING GRADERS

How to S-T-R-E-T-C-H your Steel Supply

It's really simple. Just use "the steels that do more"—U·S·S Cor-Ten or U·S·S Man-Ten—in place of carbon steel. And your steel supply will *go one-third* farther.

By taking advantage of the higher physical properties of these high-strength steels, you can use thinner sections to produce units that weigh one-fourth less . . . that are substantially stronger and more durable . . . that require one-fourth less steel per unit. As a result, in many cases, you can produce as much as one-third more units from every ton of steel used.

Since both U·S·S Cor-Ten and U·S·S Man-Ten, like plain carbon steel, can be readily fabricated . . . since one-fourth less steel is required per unit, with consequent reduction in shipping costs . . . since fixed charges can be spread over one-third more units . . . your finished product can be built at little or no increase in cost.

CALL US FOR . . .
"THE STEELS THAT DO MORE"

U·S·S Cor-Ten and U·S·S Man-Ten steels are stocked by our eleven warehouses located in principal cities across the country. Our other High Strength Steels, U·S·S Abrasion Resisting and U·S·S Manganese-Nickel-Copper are also stocked to satisfy your various requirements.

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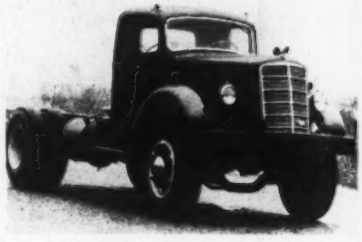
UNITED STATES STEEL

lically controlled, and when folded down, overall machine height is 9 ft. 6 in. Total track height is 16 or 18 ft. The lift will operate up to 20 mph. forward and 30 in reverse, but towing is suggested for high-speed transporting.—*Mixermobile Manufacturers, 6855 N.E. Halsey St., Portland, Ore.*



TRUCK TRACTOR—Powered by a 431-cu. in. Thermodyne engine, a 45,000-lb. basic gross-combination-weight tractor is specially designed for high-speed operations. The engine develops 139 hp. at its governed 2500 rpm. and has a high torque output of 330 ft.-lb. at 1400 rpm. A 13⅞-in. dia. single-plate dry clutch links the engine to either a five-speed or new ten-speed duplex transmission. Box-girder construction produces a strong frame and safety is stressed throughout. Air brakes have 533-sq. in. area.—*Mack Trucks Inc., New York, N. Y.*

ROAD MAINTAINER—Developed for maintenance of dirt and gravel roads, the 1948 Maintainer is a standard model with 20,000-lb. gross rating and chassis weight of 8,000 lbs. Standard wheelbase is 154 in., and frame length back of the cab is 121½ in. Empty frame height of 45½ in. and 40¾-in. loaded height enables accommodation of any underbody maintenance blade. High arched springs and overhead spring shackle mounting make the extra frame height possible. Load concentration on the rear axle results in more regular blade action.—*Four Wheel Drive Auto Co., Clintonville, Wis.*

PORTABLE THREADING MACHINE—Eliminating the need for a chuck wrench, an electrically-powered pipe and bolt threader is equipped with a "Spinfast" front chuck. Standard range

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2. Unit Assembly for simplified service
3. 5 Identical Clutches
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14. Positive Independent Shovel Crowd
15. All-Purpose Crane Boom
16. Gooseneck Hoe Boom

EXAMINE the list of features at the left. It's the inside story of a truly modern shovel and crane. Never before have so many functional features been packed into a small machine. Every one has been incorporated for just one purpose—to make the Lorain TL-20 the most versatile and profitable machine that ever hoisted a dipper or cast a bucket in the ½ yd. class.

And wherever a TL-20 goes to work, production news is in the making. For example, this TL-20 of the Kutchera Sodding and Fuel Co., Cedar Rapids, Iowa, averages 75 yds. per hour on a precision farm ditching job. And so it goes—more features, more yardage and more enthusiastic TL-20 owners. Better ask your local Thew-Lorain distributor for a first-hand examination of a nearby TL-20 today.

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Velvetouch ALL-METAL STEERING CLUTCH FACINGS ON THE NEW HD-19

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Like other leading manufacturers of heavy duty tractors and earthmoving equipment, Allis-Chalmers specifies Velvetouch for dependable power control. Because the powdered metals, used in making Velvetouch clutch facings and brake linings, are scientifically processed to minimize chattering and slipping . . . insure smooth, positive action. Genuine Velvetouch lasts longer, too . . . for it's *all-metal* . . . can't rot in oil or "burn" like conventional material. Send for descriptive literature today.

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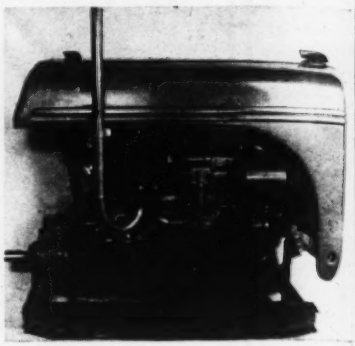
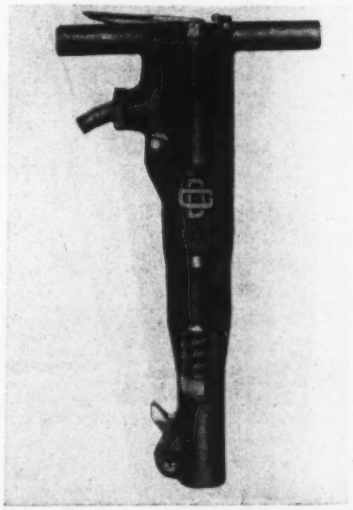


STATIONARY POWER UNITS — Mounted on a skid base and equipped with a heavy-duty clutch assembly, oversize oil pan, and radiator, the semi-portable power units are built around Ford 4–40 hp.; Ford V-8, 100 hp.; and Lincoln 120 hp. engines. Optional equipment permits gasoline, diesel, butane, propane, or natural gas operation, and power take-off pulley or sheaves are furnished to comply with purchaser's specifications.—*Funk Mfg. Co., Coffeyville, Kan.*



PAVING BREAKER—A 63-lb. concrete breaker with 23-in. over-all length, model B67, can be fitted with chucks for 1⅛ or 1¼-in. hexagonal tools. Its design incorpates a safety latch on the throttle valve handle and a lubricator providing sufficient capacity for several hours' operation.—*Gardner-Denver Co., Quincy, Ill.*

Along the pipe line, engineering judgment can often decide one way or the other—a centrifugal blower, a reciprocating compressor. The decision is tempered by two things: (1) knowledge of what is at each end of the pipe line, i.e., the source of gas and the storage at the consumer end; and (2), the salesman's ability to offer different types of equipment.

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S.R.P. goes on like paint, forms an impenetrable, rust-inhibitive barrier against moisture, corrosive salts, acid fumes and vapors and weather exposure. Its protective film expands and contracts with the temperature to prevent cracks and peeling.

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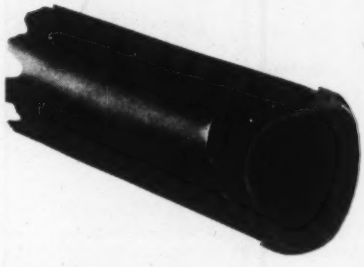
HYDRAULIC POWER UNIT—Equipped with an air-cooled gasoline engine, the Paul Bunyan, Jr. unit puts hydraulic power into the portable class. The 16 x 28 x 36-in. unit can supply 3 gallons of oil per minute at 1000 psi. The gear pump is mounted integrally with the operating valve, which has a ball-handle lever operated at forward, neutral and reverse positions. Only two operating line connections need be made to prepare the unit for service.—*Hydraulic Press Mfg. Co., Hydro-Power Division, Mt. Gilead, Ohio.*



PILE TIPS—Bearing value of a pile is increased and driving is straight with the Cobi pile tip. With full ground contact over the entire area of its inverted paraboloid, the tip builds a tightly consolidated pressure bulb of greater density, reducing settlement to the minimum. Tips are available for timber, precast concrete and cast-in-place steel piles.—*Albert Pipe Supply Co., Inc. Berry & N. 13th St, Brooklyn 11, N. Y.*

ELECTRIC DRILL KIT—This convenient drill kit has a place for everything, beginning with a Mall Drill complete and ready for operation. It has eight drill bits of different sizes and a sturdy, compact carrying case. Rack for drills is hinged so that it may be pulled forward to remove drills and pushed back into place. Drills cannot fall out.—*Mall Tool Co., 7740 South Chicago Ave., Chicago 19, Ill.*

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HEAVY DUTY

DUMP BODIES

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NOW MORE RUGGED THAN EVER

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For the *many other advantages* of Gar Wood Heavy Duty Dump Bodies and Hoists, see *new* Bulletin HB-302. Ask your dealer for a copy or write directly to factory.

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Two types of Starbilt construction are illustrated by these canning plant buildings erected at Harlingen, Texas. Note the dormers on the building at the left, and the special ventilators on the smaller building at the right—also the difference in window requirements. Star steel buildings are always constructed to your specifications . . . built to suit your individual needs. Yet you realize the amazing economy of prefabrication when you—

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Manufacturers' Publications

Insulating Roof Tiles—(8-p. pamphlet) Deals with Kaylo roof tile, a structural unit having high insulating value designed to carry roof deck loads of 50 lb. per sq. ft. Composed of noncombustible minerals. Specifications, design data and details for engineers and contractors. Technical data include tables on insulating value, strength, weight, dimensional stability and nail-holding power.—*American Structural Products Co., Toledo 1, Ohio.*

Drafting Equipment—V. & E. Manufacturing Co. has issued a 16-page booklet illustrating and describing Vemco drawing instruments and drafting machines.—*V. & E. Mfg. Co., Pasadena 20, Calif. (P. O. Box 950).*

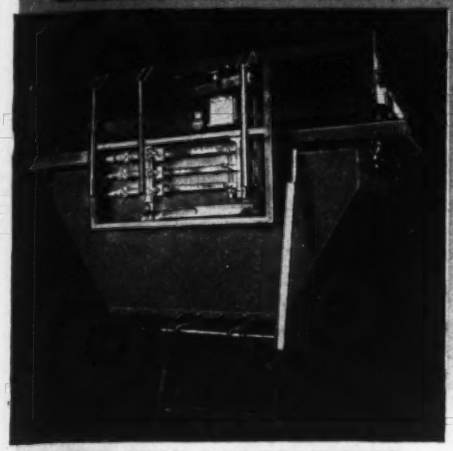
Crushing and Screening Plant—Available for general distribution to the aggregate producing industry is a new booklet on the Pioneer Engineering Works' line of combination portable 2-unit crushing and screening plants. The booklet covers primary and secondary rock and gravel plants, featuring the portability and versatility of the plants to meet the varying conditions for aggregate production. Complete specifications are given, together with a guide to proper selection of equipment.—*Pioneer Engineering Works, Inc., Minneapolis* 13, *Minn.*

Fire Doors—(12-p. booklet) issued by the National Metalclad Door Association, this booklet is directed to building officials, fire prevention officials, architects and engineers who are responsible for specifying fire doors in buildings. The booklet offers revised and more complete definitions for code and ordinance purposes, and a more comprehensive means of specification.—*National Metalclad Door Ass'n., 550 Ellicott Square, Buffalo 3, N. Y.*

Conveyors—(4-p. booklet) Bulletin No. 125-A presents two pages of pictures showing twelve popular units manufactured by the Robins Conveyors Division. The bulletin serves as a reference catalog of items used in handling bulk materials in quantity.—*Robins Conveyors Division, Hewitt-Robins Inc.,* 270 *Passaic Ave., Passaic, N. J.*

Electric Motors—(11-p. booklet) Information on Allis-Chalmers general purpose motors for industry is contained in a new Handy Guide for Quick Selection of Electric Motors. The bulletin

Let's Have Your SAND, STONE *and* CEMENT STORAGE *and* BATCHING PROBLEMS



ERIE'S AggreMeter Line, backed by over a quarter century of application experience, is at your service. From the smaller GA Portable AggreMeters to the largest of central plants that combine Aggregate and Bulk Cement handling, Erie is prepared to meet your needs. May we direct you to some Erie AggreMeter installation near you, or let's have your immediate problem for recommendations. We list standard plants, left below. Write for bulletins.

NEW BWC AGGREMETERS

ERIE presents this new sturdy all-welded, easy operating line of weighing AggreMeters. They feature new type scale suspension with few parts. Erie's distinctive discharge method is well known for fast charging service. Type BWC units are available in 1 1/2, 2, 3, 4, and 5 cu. yard sizes.

OTHER ERIE AGGREMETERS

TYPE GA
Portable Plants
36, 52, and 68 cu. yard sizes

TYPE CAB
3-Compartment
74, 88, 107, 129, 150, and 211 cu. yard sizes

TYPE CTB
Like Type CAB
Only with Long Columns

TYPE CTE
4-Compartment-in-Line
145, 160, and 200 cu. yard sizes

TYPE CTC
Like Type CTE
Only with Long Columns

TYPE M
Portable Cement Bins
Single Compartment
29, 45, and 73 cu. yard sizes

TYPE L
Single and Double Compartment
90, 112, and 148 cu. yard capacity

ERIE
TYPE CTB
129 cu. yard AggreMeter
with
M-3—73 cu. yard
Cement Bin

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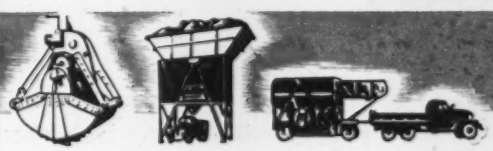

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These rugged pile hammers operate at medium steam pressure, delivering a moderate frequency of telling, low velocity blows from a relatively heavy ram. All working parts are exposed for easy accessibility.

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provides detailed specifications covering squirrel-cage induction motors and application data, range of sizes and speed torque curves on synchronous, wound rotor and direct current motors. Also stressed is the company's complete line of motor controls for every requirement of motor operation, with charts listing the range of each type of control in voltage and horsepower. — *Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.*

Soil Cement—(32-p. bulletin) Bulletin No. 50 is a non-technical discussion on the processing of soil-cement with the Seaman Pulvi-Mixer. Intended primarily for the man on the job, it applies to the contractor, paving official and as a ready reference on processing. Text describes mixing action, several recent improvements, and adaptation and application to soil-cement construction.—*Seaman Motors, Inc., 305 N. 25th St., Milwaukee, Wis.*

Transit—(4-p. brochure) A 4-page brochure combining a catalog and calculating chart has been prepared to illustrate twelve types of instruments, from an 18-in. level to a plane table alidade. On the back of the brochure is a chart which gives at a glance the length of arcs.—*C. L. Berger & Sons, Inc., Boston, Mass.*

Rock Bits—Catalog RB-1 lists a newly announced line of chisel-type cemented carbide rock bits for pneumatic percussion drilling. Catalog contains information on the new sizes of 1⅜ in., 1½ in., 1⅝ in., and 1¾ in., describing them in detail and pointing out the advantages of drilling with this type of equipment.—*Kennametal, Inc., Latrobe, Pa.*

Wall Charts—In line with the recent formation of their Wire Rope Sales Division, R. G. LeTourneau, Inc. has published a new Tournarope wall chart. This chart lists the features incorporated into the design and production of Tournarope; gives the types and constructions; and lists its applications in the earthmoving, hauling and lifting equipment fields. On the inside fold of the chart are listed the cable requirements for LeTourneau scrapers, dozers, cranes and rooters.—*Advertising Department, R. G. LeTourneau, Inc., Peoria, Ill.*

Hoists—(15-p. booklet) Catalog HE8 gives data on the "Erectors" model 2-speed hydro-hoists, 60 to 100 hp., with two-speed automotive transmission and hydraulic finger-tip control.—*The Jaeger Machine Co., Columbus 16, Ohio.*

Compressors—(4-p. bulletin) lists the advantages of small portable compressors with trailer mounts that can be taken to any job behind any make or model of car.—*The O. K. Clutch and Machinery Co., Columbia, Pa.*

Stress-Strain Recorders—(32-p. catalog) Bulletin 262 is a catalog of Baldwin stress-strain recorders and strain followers, describing the basic principles of the various types of recorders; gives the distinguishing features of 24 different recorders for all common makes of testing machines, and describes more than 50 extensometers, compressometers and deflectometers that can be used with the recorders.—*The Baldwin Locomotive Works, Testing Equipment Department, Philadelphia 42, Pa.*

Lighting Systems—(28-p. booklet) A comprehensive bulletin on the popularly acclaimed new louvered ceiling lighting system—the "Sky-Glo" system. The bulletin is said to answer demands for comprehensive data and gives complete general specifications.—*The Benjamin Electric Mfg. Co., Department N.R., Des Plaines, Ill.*

Metal Joining—(8-p. bulletin) Containing more than 60 illustrations, a new bulletin explains in non-technical language how Eutectic low temperature welding alloys compare with welding and brazing processes. The issue is devoted to explaining how 15 of the most popular Eutectic alloys can save defective equipment and machinery and how the process of low heat welding is used to most advantage in construction work and fabrication—*Eutectic Welding Alloys Corp., 40 Worth St., New York 13, N. Y.*

Roofing—(24-p. booklet) A new illustrated booklet is designed to aid architects and contractors in educating their customers on the importance of a good roof. The booklet, "One Metal Roof . . . for the Life of Your Building," discusses the destructive effect on roofs of smoke, fumes and other corrosive agents common to industrial centers. Full data on a new, soft-temper Monel roofing sheet is presented.—*International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.*

Corrosion Control—Use of "Micromet" in controlling corrosion, preventing lime scale and stopping "red water" discoloration in water systems is described in a new folder.—*Calgon, Inc., Pittsburgh, Pa.*

Steel Fabrication—(32-p. booklet) Illustrated with photographs, tables and charts, this booklet is designed to supply fabricators with late and authentic

(*Continued on page* 141)

information on the selection and fabrication of both solid stainless steel and stainless clad plates, whether used alone or in combination with each other. —*Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.*

Spray Machine—A new bulletin describes operations of the Flex-Plane automatic spray machine for applying membrane curing material to concrete roads and airports.—*Flex-Plane, Warren, Ohio.*

Highway Shoulders—Booklet, "Highway Shoulder Improvement Methods," is for the use of design, maintenance and roadside development engineers and for landscape and parkway architects. It deals concisely with widely extended problems now attending overcrowded highways.—*Seaman Motors, Inc., 305 N. 25th St., Milwaukee 3, Wis.*

Gate Valves—(12-p. circular) A new circular, No. 534, presents a new line of "Union bonded" bronze gate valves, 200 lb. S.P.; 400 lb. W.O.G. The literature illustrates the advanced design of these new valves, characterized by the first application of full cylindrical body sections to bronze gate valves.—*The Lunkenheimer Co., Cincinnati 14, Ohio.*

Wire Rope Sling—A new bulletin, FLS-48, gives details on a new flat-laced wire rope sling made of six parts of wire rope laced together to form a flat, strong, flexible lifting device.—*A. Leschen & Sons Rope Co., 5909 Kennerly Ave., St. Louis 12, Mo.*

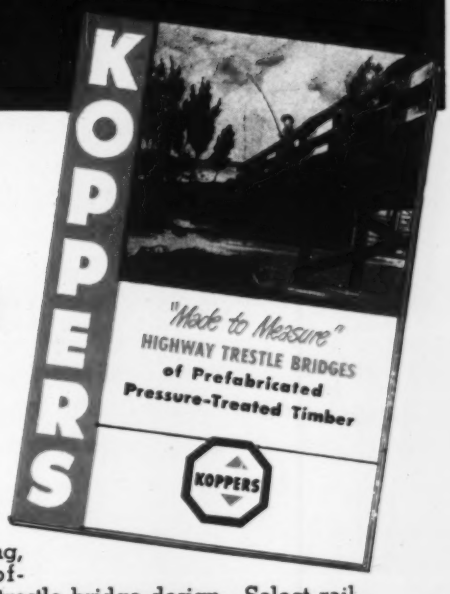
Prime Pumps—The complete new line of Rex "Easy Flow" speed prime pumps is illustrated and described in Bulletin No. 47-12. Design advancements are described in detail and pictured by cutaway and exploded photos, and detailed specifications and application information and tables are included.—*Chain Belt Co., 1600 W. Bruce St., Milwaukee 4, Wis.*

Altimeter—The new W&T precision altimeter is a low-range surveying altimeter that will determine elevations accurately in about one-tenth the time required by vertical angle or spirit leveling. The altimeter has a range of 2000 ft. and may be read easily to the nearest foot.—*Wallace & Tiernan Products, Inc., 1 Main St., Belleville 9, N. J.*

Power Grader—Bulletin No. 141 describes a new power grader for heavy duty grading, ditching, filling and road building jobs. It illustrates the M-B power grader operating with such attachments as a power sweeper, scarifier, snow plow, and others.—*Meili-Blumberg Corp., New Holstein, Wis.*

Save construction Time and Cost with

KOPPERS PRESSURE-TREATED TIMBER



Save Design Time and Cost with this BOOK . . .

Save laborious designing, detailing and bill-of-material preparation in trestle bridge design. Select railing, deck, bent and abutment types desired from this "Made to Measure" bridge book . . . fill out data sheet . . . and mail for quotation. Bridge members available framed and treated; only assembly needed at site. Erect with highway crews plus local labor, no special equipment. Decay-protected—low maintenance cost. If you build trestle bridges, ask for a complimentary copy.

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PITTSBURGH 99, PA.

THEY SPECIFY "Automatic" Sprinklers
FOR DEPENDABLE PROTECTION...
IN THE EMPIRE STATE and Everywhere

FIRE can do only the damage you permit it to do. If it destroys your possessions, it is because those possessions are permitted to be food for flames, and there is really nothing at all mysterious about the process of combustion.

Scientists have expended considerable energy in their attempts to master fire, yet, at every hand stand ruins, evidence of their failure. Only protection from fire has been steadily advanced, and "Automatic" Sprinklers today stand as science's greatest contribution to the never ending battle against fire destruction.

The accomplishments of "Automatic" Sprinkler, during more than sixty years of fire protection pioneering, spell constant advancement and development. The results are best measured in terms of product dependability and service... substantial reason why "Automatic" Sprinklers figure more and more prominently as specified equipment for both old and new construction. *They're an important investment today... perhaps welcomed protection tomorrow.*

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FIRST IN FIRE PROTECTION
DEVELOPMENT · ENGINEERING MANUFACTURE · INSTALLATION

AUTOMATIC SPRINKLER CORPORATION OF AMERICA
YOUNGSTOWN 1, OHIO
OFFICES IN PRINCIPAL CITIES OF NORTH and SOUTH AMERICA

Manufacturers' Activities

Sales—W. W. McCarron has been appointed sales engineer for marine and stationary diesel engines by the NORDBERG MFG. CO., Milwaukee, Wis. . . . Promotion of Thurman Manley from Nashville, Tenn., office manager to sales representative for Middle Tennessee has been announced by the UNIVERSAL CONCRETE PIPE CO. . . . Robert A. Grace is manager of the western sales division of THE SCHAIBLE CO., plumbing fixtures and valves, Cincinnati, Ohio, and Robert E. Rielly is advertising and sales promotion manager . . . George E. Athana has rejoined YORK-SHIPLEY, INC., as sales manager of the New York territory . . . J. M. Haughey is sales manager of the WASHINGTON IRON WORKS, Seattle, Wash. . . . Whitley B. Moore is vice-president in charge of sales of the TIMKEN ROLLER BEARING CO., Canton, Ohio. . . . George J. Fischer is manager of national accounts of the industrial products sales division of THE B. F. GOODRICH CO. and Jas. M. Flounders succeeds him as product manager . . . Edson K. Green has been made general sales manager of the INTERNATIONAL SALT CO. INC., Scranton, Pa.

Distributors—GEORGE PARKER TRACTOR CO., Macon, Ga., has a full line distributor for the DAVEY COMPRESSOR CO. for northern Georgia, adjacent to the territory of FLORIDA-GEORGIA TRACTOR CO. . . . THE NATIONAL MILL SUPPLY CO., Fort Wayne, Ind., is now a dealer for DAVEY COMPRESSOR CO., Kent, Ohio. . . . . THE TENNESSEE HEATING SALES CO. Knoxville, has been appointed distributor for DRAVO "Counterflo" heaters in Tennessee, east of the Tennessee River, southeast Kentucky, Northwest Virginia and North Carolina, west of Asheville.

Personalities—John R. Swikard has been named plant manager of the Cincinnati factory of THE SCHAIBLE CO., plumbing-heating manufacturers. . . . . A. B. Ardway has been appointed to the executive staff handling the overall policies of the HENRY J. KAISER industries . . . Herbert W. Pope has been made assistant to the president of the LAWRENCE PORTLAND CEMENT CO. with headquarters at 150 Broadway, New York, 7, N. Y. . . . Howard B. Steggall, vice-president in charge of the U. S. RADIATOR CORPORATION'S Pacific steel boiler division has been elected a director. . . . James D. Hodges has been made eastern divisional manager of the port-

CUT THE DOWNTIME! . . . SPEED UP THE JOB! . . .
INCREASE THE PROFIT! WITH . . .

Firestone TIRES

LESS DOWNTIME . . . MORE SPEED . . . MORE DIRT MOVED . . . THESE ARE THE KEYS TO PROFIT ON ANY JOB

Firestone pioneered in building big tires for earth-moving and other off-the-highway equipment, and through the years, Firestone has licked all the problems of off-the-highway operation.

Backed by this experience, Firestone knows how to build tires that take the gaff day in and day out . . . tires that cut costly downtime . . . tires that speed up the job and help you make a profit.

Give Firestone tires a trial. Let them prove themselves on your equipment on the toughest job you have. They will save you money.

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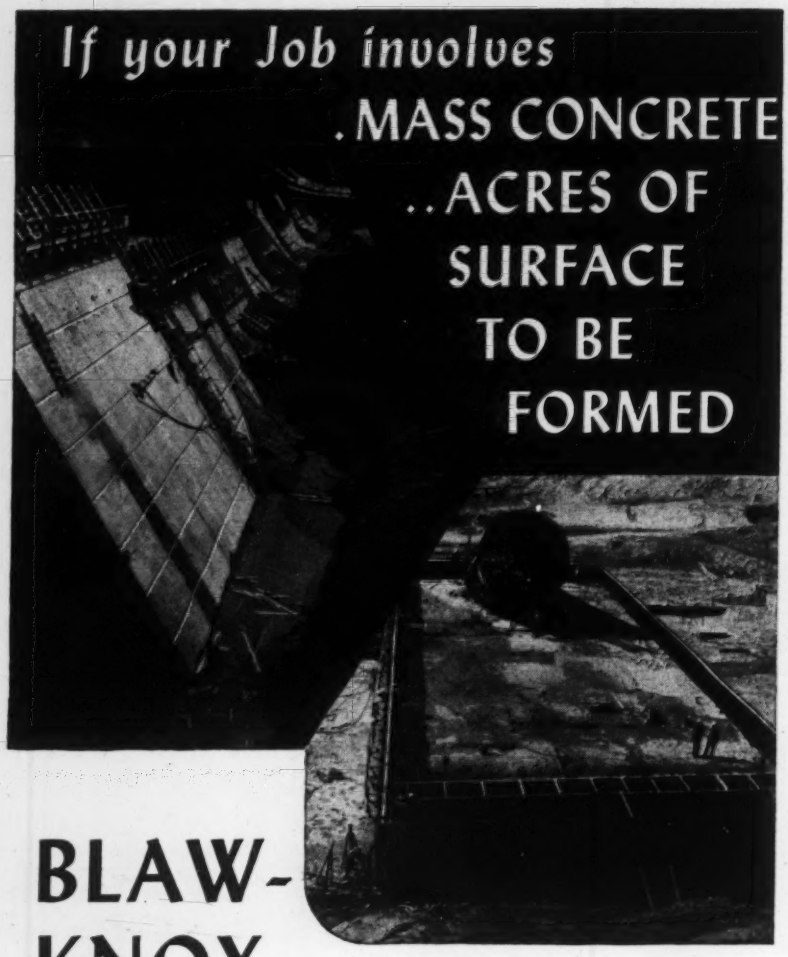
Firestone OFF-THE-HIGHWAY TIRES



BLAW-KNOX *has devised an ingenious* STEEL FORMING *method for you*

Blaw-Knox has proved the practicability of its forming method for pouring concrete monoliths of gravity type dams—a design of steel form which is easily handled through successive lifts—and which can easily be aligned for all job conditions.

It would be our pleasure to tell you about this tried and proved system of BLAW-KNOX STEEL FORMS for concrete monoliths. You will incur no obligation by asking for this information.

Blaw-Knox STEEL FORMS have been serving engineers and contractors for over 40 years. The Blaw-Knox record of accomplishment is shown in Catalog 1836. Send for a copy.

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able heaters and ventilators of the HERMAN WILSON CORP., Moline, Ill. . . . Robert J. Russell has been elected secretary and appointed chief of the technical staff of HARDINGE CO. INC., York, Pa.

Miscellany—San Francisco has been chosen as the new western divisional branch office of the CLIPPER MFG. CO., masonry saws, the location being 422 Market Street . . . BROWN INSTRUMENT CO. will feature new types of electronic potentiometers and an operating exhibit of the new RemoteSet system at the third national instrument conference, Sept. 13-17 at Convention Hall, Philadelphia . . . THE SCHAIBLE CO. has started shipments of fittings, valves and heating specialties from its western sales division at 707 South Raymond Ave., Pasadena, Calif. . . . H. K. FERGUSON CO., Cleveland, Ohio, has formed a new atomic energy division to specialize exclusively in nuclear engineering problems with Karl Cohen in charge . . . A new customer engineering service department, under Robert C. Singleton, has been established by the Nelson stud welding division of MORTON GREGORY CORP. at its Lorain, Ohio, headquarters . . . VICTOR EQUIPMENT CO., manufacturer of flame cutting appartus and distributor of welding supplies for 38 years, has opened a new Chicago branch office and assembly plant at 1,312 West Lake Street . . . THE FOUR WHEEL DRIVE AUTO CO. this month is holding its third dealer service training school at its home factory, Clintonville, Wis. . . . THE EUCLID ROAD MACHINERY CO., Cleveland, Ohio, announces the appointment of W. A. Hoffman as sales representative for the Canadian provinces of Ontario, Quebec, Manitoba and Saskatchewan.

Penna. road bureau to ask 5% proposal guaranty

Pennsylvania's highway department has discontinued the practice of setting flat proposal guaranty amounts on bids asked for highway construction contracts.

The department, starting Aug. 20, will request bidders to submit a proposal guaranty of at least five per cent of the total amount of the bid, except that on no project shall the guaranty be less than $500. This represents a departure in procedure from the practice they have followed in the past.

Previously the amount of the guaranty was stipulated when bids were asked. It was set in round figures based on an estimated five per cent of the project cost.

STANDARD ENGINEER'S REPORT

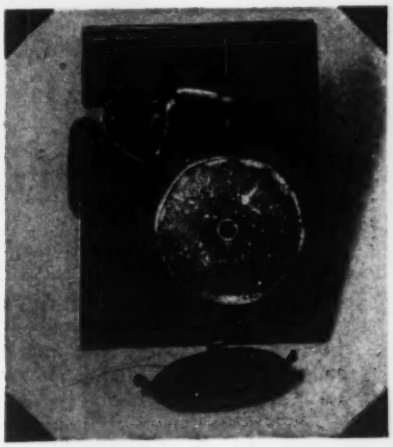
RPM CALOL

TEST DATA

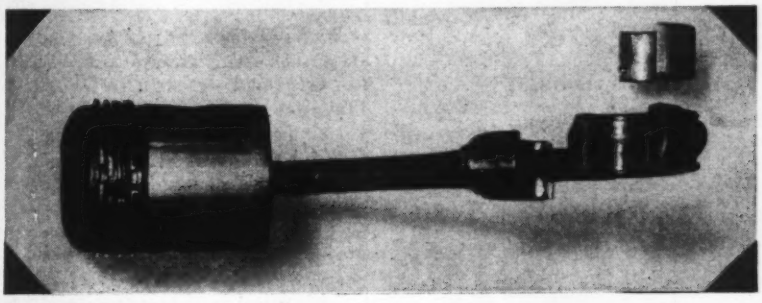
UNIT	8 cyl. High Compression Bus Engine
LUBRICANT	RPM Heavy Duty Motor Oil SAE 30
MILES RUN	90,371
CONDITIONS	Highway Operation - Below freezing to desert heat
FIRM	Moyers Stages
LOCATION	Fresno, Calif.

GASOLINE BUS ENGINE RUNS 90,371 MILES IN CLIMATIC EXTREMES WITHOUT SLUDGE OR CARBON TROUBLE

This bus engine was torn down after operating in regular highway service for 90,371 miles on RPM Heavy Duty Motor Oil ... average speed, 50 M.P.H. with many starts and stops. Inland valley weather conditions - below freezing in winter to more than 100° F. above zero in the shade in summer. As the photograph shows, the inside of the engine was exceptionally clean. RPM Heavy Duty Motor Oil's special detergent compounding keeps all engine parts cleaner.



The oil-pump screen was clear and no deposits had accumulated in the crankcase pan. With RPM Heavy Duty Motor Oil, any lacquer, carbon, sludge or other foreign matter is dispersed in the oil and flows out when the crankcase is drained.



All rings were free and bearings in good condition as indicated by this piston and connecting rod from the engine. RPM Heavy Duty Motor Oil loosens and removes lacquer and carbon from around rings -- keeps oil return holes open and deposits from building up in grooves. It is not corrosive to any bearing metal.

REMARKS: RPM Heavy Duty Motor Oil SAE 30 was in this engine from the time the engine was new and first put in service. The crankcase was drained at regular intervals. Special compounds in RPM Heavy Duty Motor Oil give it the ability to keep engines clean, adhere to both hot and cold spots in engines, resist oxidation, prevent corrosion and foaming.

STANDARD TECHNICAL SERVICE conducted and reported this test: If you have a lubrication or fuel problem, your Standard Fuel and Lubricant Engineer or Representative will give you expert help; or write Standard of California, 225 Bush Street, San Francisco 20.

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Supply problems got you all at sea?

Air Express is the *fastest service* you can buy. Use it regularly to ship and receive supplies, equipment and parts. It solves your shortage problems in a matter of hours.

Air Express shipments go on *all flights* of the Scheduled Airlines. There's no waiting around with this speedy 24-hour service. Special pick-up and delivery is included at no extra cost, and Air Express rates are *low*. It pays to standardize on Air Express.

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- Moves on all flights of all Scheduled Airlines.
- Air-rail between 22,000 off-airline offices.

True case history: Dallas motor repair shop regularly gets supplies by Air Express. Keeps equipment rolling. Typical shipment: 60-lb. carton of rubber hose picked up in Indianapolis 5 P.M., delivered 9:30 A.M. following day. 777 miles, Air Express charge only $14.74. Any distance similarly inexpensive. Phone Air Express Division, Railway Express Agency, for fast shipping action.

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Rates include pick-up and delivery door to door in all principal towns and cities

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SCHEDULED AIRLINES OF THE U.S.

Men and Jobs

The Lehigh Portland Cement Co. has announced the appointment of **Leon D. Holden** as project engineer. He was formerly director of the cement, lime and allied plants division of the Vulcan Iron Works and for the last year was an engineer in the division of bridges, California. He served 18 years with the Lehigh Portland Cement Co. as a design engineer before leaving in 1942 to do war work with the DuPont Co. and Chicago Bridge & Iron Works.

Maj. Gen. Joseph Cowles Mehaffey has assumed his new post as Ohio River Division engineer in Cincinnati. General Mehaffey, who has been on 60-day leave since retiring as governor of the Panama Canal Zone, succeeded **Maj. Gen. Douglas L. Weart,** who became commanding general of the Army's engineer center at Fort Belvoir, Va., two months ago.

G. Clinton Brookhart and **Raymond J. Tyo** have established the firm of Brookhart & Tyo, Inc., Engineers, as successors to G. Clinton Brookhart, Engineers. Offices will remain at 6th and Maclay Sts., Harrisburg, Pa.

Wayne T. Rye, Sr., former commissioner of rural highways in Kentucky, has been made assistant to Dwight H. Bray, state highway engineer.

Ralph G. Lingley has been appointed town manager of Bloomfield, Conn. A graduate of Clark University, Mr. Lingley served 15 years in the Worcester, Mass., engineering department in charge of streets, water, and sewer construction and maintenance. He was assistant street commissioner for two years and for four years sewer commissioner. For three years he was sanitary engineer at Camp Devens, Mass., and lately has been on the engineering staff of Metcalf & Eddy, Boston consultants.

Lewis W. Klockner, Jr., has become a special consultant to the water department at Trenton, N. J., succeeding Alvin Bugbee, retired.

B. O. Vannort and **W. A. Kurtz,** of Charlotte, N. C., have formed B. O.

Vannort Engineers, Inc., which will do a general engineering business.

William H. Kendall, formerly division engineer with the Pennsylvania Railroad at Erie, Pa., has been named staff assistant to the vice-president in charge of operations of the Atlantic Coast Line Railroad, with headquarters at Wilmington, N. C.

James P. Exum has resigned as bridge engineer of the Texas highway department to join Howard, Needles, Tammen and Bergendoff, consulting engineers in New York. He is a civil engineering graduate of the University of Michigan, and his work has been unusually noteworthy. He is credited with adding architectural beauty to structural utility, making Texas bridges among the most attractive in the country.

Randle B. Alexander, a graduate of the University of Michigan, succeeds Mr. Exum as bridge engineer. He has been with the Texas highway department for 25 years. He is a veteran of both world wars.

Elections and Activities

A Tri-State Soil and Water Council of the Maumee Valley was formed recently at a meeting in Napoleon, Ohio. The council will be composed of four members from each of the three states—Indiana, Ohio and Michigan—for four-year terms. Provision was made in the constitution for a general membership of interested persons in the 23-county area at an annual fee of $1 each. Executive committees formed in each state will represent all of the affected areas in that state. The Indiana representatives appointed to the Council are J. C. Kohr, president, Fort Wayne Izaak Walton League; Louis H. Dunten, member, Indiana Flood Control Commission; Charles A. Phelps, former state senator, and Thomas P. Riddle. The Michigan and Ohio directors will be selected later.

The International Association for Hydraulic Structures Research at its recent meeting in Stockholm, Sweden, selected Grenoble, France, for its meeting in August, 1949. It also selected

I'M YOUR MAN

FOR TRIPLE SAVINGS
...AND THE *NEW*
"VIC-GROOVER"!

VICTAULIC COUPLINGS give piping systems a *flexibility* that minimizes bends and fittings . . . keep every joint *leak-tight* under pressure or vacuum... make joints *positive-locked* so they can't blow off or pull out under vibration or sag.

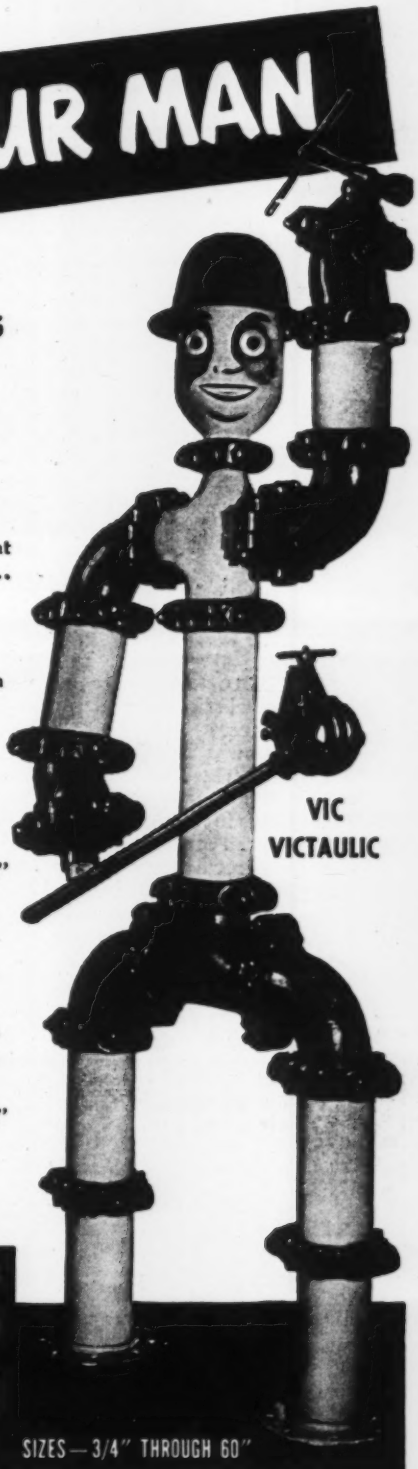
JUST A FEW TWIRLS of a T-wrench buttons up a Victaulic system...or unbuttons it—with no special skill or training needed!

THIS SAVES YOU money, man-hours, material...in assembly, repair, or salvage!

AND NOW! A new "VIC-GROOVER" grooves pipe ends automatically and twice as fast...with half the effort of ordinary pipe threaders.

FOR FULL ECONOMY, make your piping system *ALL*-Victaulic—with Victaulic Couplings and Victaulic Full-Flow Elbows, Tees, and other Fittings ...and the new "VIC-GROOVER"!

Write today for new "VIC-GROOVER" Catalog VG-47...and also ask for Victaulic Catalog and Engineering Manual No. 44.



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MM TIME-TESTED POWER

MM 1210-12A power was selected for this 30 inch drainage pump to obtain dependable high performance with very little maintenance.

MM power unit features that give smooth power and dependability are drop-forged crankshafts that have large bearing surfaces for smaller bearing loads per square inch—dynamic balancing of crankshafts for smooth operation. Camshafts are made of long wearing Proferall metal and are driven by helical gears. MM controlled cooling directs water to combustion chamber and valve ports for more efficient combustion and longer valve life.

MM power units are built to give maximum economy with gasoline, distillate, natural gas or butane fuel . . . to provide lowest cost power for continuous or intermittent duty jobs. Available from 25 up to 230 H. P.

See Your MM Dealer-Distributor or Write

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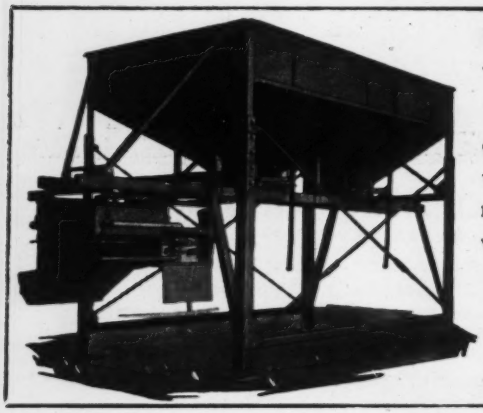
MINNEAPOLIS 1, MINNESOTA



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Complete—with scale for two or three aggregates.
With two or three overhead storage bins.
For use on culvert—bridge—curbing—foundation jobs.
Wherever above size mixers are in operation

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the meeting place of its next triennial conference to be held in Delhi, India, Feb, 1951. New officiers elected, effective January 1, 1949, are President, Lorenz G. Straub, U.S.A. (Minneapolis); 1st vice-president, Prof. E. Meyer-Peter, Switzerland; 2nd vice-president, A. N. Khosla, India; secretary, Prof. J. Th. Thijsse, Netherlands. Permanent committee members include, in addition to officers, Prof. G. De Marchi, Italy; Dr. P. Danel, France; and Sir Claude Inglis, England. Corresponding members are Prof. B. Hellstrom, Sweden, and M. Bayer, Czechoslovakia. Prof. Wolmar Fellenius, the retiring president was elected honorary member and ex officio member of the permanent committee.

Sidney A. Edwards, managing director of the Connecticut Development Commission, was elected president, and Robert C. Lane, executive director of the Vermont Development Commission, was elected a director of the Association of State Planning and Development Agencies which met recently in Nashville, Tenn.

At a recent meeting of the Contractors State License Board of California H. Cedric Roberts was elected chairman of the board for the ensuing year. A general building contractor of Burbank, he is noted for his achievements in the residential type of construction, and served the last year as vice-chairman of the Board. He succeeds William Nies, plumbing contractor of Los Angeles as chairman. J. A. McNeil was chosen as the new vice-chairman.

Charles F. Lucks, of Battelle Memorial Institute, has been elected president of the Columbus, Ohio, Technical Council. W. E. L. Bock, of Superior Die, Tool and Machine Co., was elected vice-president, and Harry Blank, Seagrave Corp., secretary-treasurer.

Leonard N. White, engineer-director of the Pulaski County Planning Board is the first president of the Arkansas Board of Registration for Professional Engineers to be elected to a second term during the board's 23-year history during which the board also re-elected N. B. Garver vice-president and V. K. Scott secretary-treasurer. R. J. Rhinehart, Pine Bluff, who was appointed to the board by Governor Laney took office to succeed L. R. Parmelee, whose term expired after 16 years service.

C. F. Gore of Weldon and J. S. Pope of Halifax have been elected chairman and vice-chairman, respectively, of Unit No. 1 of the North Carolina State Highway Employees Association. The unit includes 14 counties.